What we talk about when we talk about auditory experiences:

A holistic tool for describing and evaluating auditory user experiences

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November 2019
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Abstract

This dissertation illustrates how a philosophical interpretive understanding of human experience can provide a robust foundation for interpreting, describing and structuring auditory user experiences.

In the first part of the thesis, I concentrate on why a comprehensive and holistic outlook for describing experiential structures is essential when inquiring into user experiences. I suggest Husserl's phenomenological description of consciousness and experience as the philosophical foundation for my experiential explorations. Subsequently, ontological and epistemological assumptions of Husserl's phenomenology are investigated, focusing on the ideas of intentionality and perception. Since my research focuses on auditory interaction design, I examine these concepts in terms of their implication for auditory user experiences and present them as an experiential framework.

In the second part of the thesis, I explore ways to make the investigated philosophical concepts applicable in a design process. In a pragmatic manner, I transform the experiential framework into an operable model for describing, analysing and evaluating auditory user experiences. The thesis closes with empirical explorations, which is considered primarily as an illustration of the practical application of the research conclusions.

My research project is motivated by an observed need for a theoretically grounded design tool for articulating, analysing and evaluating auditory experiences within the field of Human-Computer Interaction and Interaction Design that takes on a holistic view on our auditory experiences and ways of expressing these experiences.

In the past decade, we have experienced a growing interest within various audio-based research and design fields in understanding user experiences from a broader perspective than a sole focus on usability, psycho-acoustical and physical stimuli-response measurements. However, even though musicology has a long history of research into auditory experiences, only a few resources within the field of auditory interaction design exist on how to approach user experiences from a holistic

perspective that includes both engineering and non-engineering, as well as acoustic and non-acoustic, experiential qualities.

To describe auditory experiences from a holistic viewpoint, a broad understanding of human listening that includes both bodily and cognitive experiential processes is crucial.

Thus, the fundamental question pursued throughout the thesis is how to develop and formalise a comprehensive philosophical description of listening and experiential structures into a practical tool for interaction designers and researchers to describe, analyse and evaluate direct sound-based experiences.

In the present study, I consider listening as an active sense-making activity that is both subjective and multidimensional, and listening experiences as being depended on not only context, but also on prior experiences, anticipations, and hearing capability. Hence, the claim is that the same sound can be experienced in various ways depending on the *listening focus*, *listening mode* and *listening context*, and these three interrelated factors are present in any listening situation.

This description and structuring of human listening propose a comprehensive way to reflect, describe, analyse and evaluate auditory user experiences. The resulting product of the thesis has been shaped through a collaboration with the UX team of a large global hearing aid company and evaluated among UX professionals, a research engineer and Innovation Manager from leading companies within the audio manufacturing and service industry, and the process demonstrates how philosophical concepts can be utilised in an actual design process.

Resumé

Denne afhandling udforsker hvordan en fænomenologisk beskrivelse af den menneskelige auditive erfaringsstruktur kan oversættes til et kategoriserings- og evalueringsværktøj for UX-designere.

Forskningsprojektet er motiveret af et observeret behov for et designværktøj til at artikulere auditive oplevelser inden for Human-Computer Interaktion (HCI) og interaktionsdesign, der rækker ud over usability (brugervenlighed), psykoakustiske evalueringer og stimuli-responsmålinger.

I løbet af de seneste årtier har vi oplevet en voksende interesse for at forstå lyd og lytteroplevelser fra en mere holistisk tilgang, hvor også de emotionelle, kropslige og kulturelle aspekter er inkluderet i definitionen af lyd-baseret brugeroplevelser.

Musikvidenskab har en lang historie inden for forskning der er relateret til lytning og lydoplevelser, men denne viden bliver kun sjældent brugt indenfor lydbaseret interaktionsdesign.

For at kunne udforme en ramme, der kan beskrive lytteroplevelsers strukturer og tilhørende kvaliteter fra et holistisk perspektiv, skal vi først forstå de menneskelige erfaringsmæssige karakterer, og hvorledes disse udleves i en lydmæssig sammenhæng.

Det grundlæggende spørgsmål, der forfølges i denne afhandling er derfor hvordan de menneskelige erfaringsoplevelser med lytning som fokuspunkt, kan formaliseres til et praktisk beskrivelses-, analyse- og evalueringsredskab for UX-designere. Designværktøjet er baseret på en fænomenologisk undersøgelse af begrebet lydbaseret brugeroplevelser og en pragmatisk designforståelse. Efterfølgende vil værktøjets anvendelighed blive demonstreret og evalueret via to empiriske undersøgelser der inkluderer en analyse af høreapparatbrugeres lyderfaringer, samt en evaluering af modellen blandt lydprofessionelle fra førende danske virksomheder.

I denne afhandling er lytning karakteriseret som en aktiv, subjektiv og flerdimensionel handling, der er styret af forventninger, tidligere erfaringer, lytterkompetencer og kontekst. Påstanden er, at den samme lyd kan opleves på forskellige måder afhængigt af lytterfokus, lytterform og lytningskontekst, og i denne afhandling argumenterer jeg for, at disse tre dimensioner altid er til stede i enhver lyttersituation.

Slutproduktet fra denne afhandling demonstrerer desuden hvordan filosofiske begreber kan operationaliseres i en faktisk designproces.

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Preface

I believe research is an ongoing process that should embrace all those who have the urge to contribute for a better understanding of the world around us and inside us, whether they are researchers by profession or not. I also believe that research is about not being afraid of making mistakes, or going down the wrong path since new insights might be born out of these side-tracks that at first sight seemed inoperative. In my research journey, I chose to move down a path, not knowing whether I was heading in a fruitful or fruitless direction. This journey involved many frustrations, mainly when concepts or ideas were found hard to express clearly, and when the work did not follow the scheduled plan. However, in these frustrating periods it helped me to know that this kind of struggle is also found among some of our great philosophers; In 1902 Edmund Husserl wrote a note on an envelope after having given a lecture at the University of Göttingen on the general theory of knowledge:

> "From time to time I am born up by the conviction that I have made more progress in the critique of knowledge than any of my predecessors, that I have seen with substantial and, in some respects, complete clarity what my predecessors scarcely suspected or else left in a state of confusion. And yet: what a mass of unclarity in these pages, how much half-done work, how much anguishing uncertainty in the details. How much is still preliminary work, mere struggle on the way to the goal and not to the full goal itself, actually achieved and seen from every side? Will it not be given to me, with powerful effort redoubled and with the application of all my vital energies, actually arrive at the goal? Is this half clarity, this tortuous restlessness, which is a sign of unresolved problems, bearable? Thus I am, after many years, still the beginner and the student" (Husserl, 1999)

Thus, research should embrace the crooked and sometimes blind roads, and acknowledge that sometimes no findings may be a significant finding itself.

My research journey initially had the objective of investigating auditory user experiences concerning an audio-based mobile app. However, in the planning phase of the evaluation session, I realised that no practical tool for how to approach qualitative investigations when evaluating through an interpretive lens was available. Either they were too theoretical to be applicable in a design process or too simplistic to describe experiential structures from an interpretive position. The same problem arose in the analysis process: no practical design tool for guiding an interpretive analysis of auditory experiential responses was available. In a quick inquiry I made among interaction designers, I realised that I was not the only one experiencing this challenge. We give great attention to the behaviours of acoustic signals, psychoacoustic processes and observable sound effects, but seldom reflect on the general underlying structures of how to describe auditory experiences from a more philosophical perspective. A high number of current research projects focus on designing novel ways of interacting with audio-based interfaces through experimental prototypes. However, only a few attend to the more philosophical aspects of auditory interaction and user experiences, resulting in a limited and arbitrary vocabulary for describing auditory user experiences.

This discovery was the turning point in my research, where I went from the aim of describing interaction experiences through specific audio-based prototypes (research-through-design), to the aim of creating a holistic and philosophical grounded design tool for describing, evaluating and analysing auditory experiences. Thus, I moved from an empirical-analytic approach (i.e., explanations generated through controlled feedback-monitoring observations and methodological experimentations) to an interpretive approach (i.e., understanding the phenomenon of human auditory experience from a "first-person" point of view and how it can be applied in an interaction design process). This change in focus also meant a change in the research strategy, from my initial scheme of investigating user experiences through the design of a specific audio-based mobile application, to a general investigation of auditory experiences based on an inquiry into philosophical descriptions of experience and experiential qualities - a change from an engineering design perspective to a philosophical design perspective, with this thesis being the resulting product.

Although I try to look at auditory experiences from a broad perspective, I am aware that it is biased by my background, geography and language, but no research can overcome these biases; we can only acknowledge the existence of them.

Acknowledgement

I must begin with a note of gratitude to my family who provided me with great encouragement, and unconditional support throughout all the ups and downs experienced over these years, put up with my long periods of absence when writing up the thesis.

I would also like to give my very special gratitude to my supervisor, Gitte Stald, for her always kind and thoughtful comments, her constant support and help in putting things into the right perspective, when everything seemed impossible. She will always be of great inspiration to me.

Throughout the last part of my PhD programme, I was fortunate to have collaborated with a world-leading hearing aid company to whom I owe my gratitude, as well as the sound researcher Ingeborg Okkels, Bang & Olufsen, Brüel & Kjær Sound and Vibration Measurement and Moodagent, who took an interest in my work. Not only did they give me their time and collaboration, but also support and expertise through various conversations and interviews, without them, this project would not have been possible. They provided me with the basis of my case study, guidance, insight and inspiration.

I would also like to thank my previous colleagues at Peking University in Beijing, notably Wusheng Wang, for all his kind help and hospitality.

Last, but not least, a very special thanks to the IT University of Copenhagen for providing me with a lot of wonderful and inspirational colleagues and for offering me this research opportunity.

1. Introduction

> "This transformation of physical energy into "meaning" is completed within a fraction of a second. However, the ease and speed with which the perceptual system accomplishes this Herculean task greatly masks the complexity of the underlying processes and often times leads us to greatly underestimate the importance of considering the study of perception and cognition, particular in applied environments such as auditory display" (Neuhoff, 2011, s. 63)

As computers are becoming smaller and more mobile, non-visual modalities are increasingly being foregrounded. Although digital services make more and more use of non-visual communication, the field of Human-Computer Interaction (HCI) and Interaction Design have been, and still are highly dominated by visual thinking (Özcan, van Egmond, & Jacobs, 2014, s. 97). Today, interaction designers are well skilled in thinking in terms of shape, size, colour and material, and at creating conceptual designs in the form of visual sketches and prototypes, but are often left to arbitrary decisions based on intuition when it comes to other sensory modules. This dominant visual thinking in HCI and Interaction Design can also be traced in the language used to discuss and evaluate products or concepts, where a vocabulary aiming at non-visual communication is very limited. (Özcan, van Egmond, & Jacobs, 2014, s. 97)

Throughout the history of HCI and Interaction Design, sound has often been parenthesised and limited to a facilitating role for the visual information, rather than being an interface module in its own right (Frauenberger, Stockman, & Bourguet, 2007, s. 25) (Franinovic & Serafin, Introduction, 2013) (Rocchesso, et al., 2008) (Robare & Forlizzi, 2009), or has been applied just as a supportive module for the graphical user interface.

As computers moved away from the desktop and out into the lived environment, non-visual modalities were increasingly foregrounded. Technological systems that react to sounds or verbal inputs have also become more commonplace in our digital inventory, from digital AI assistants

(e.g., SIRI[1], Alexa[2] and Google Assistant[3]) and music recognition applications (e.g., Shazam[4]) to baby alarms, digital language translator applications and noise-cancelling headphones.

With today's widespread use of wearable and mobile devices, the advantages of sound have become even more noticeable. These advantages include the possibility for eyes- and hands-free communication, the small storage space sound files take up (Lu, Pan, Lane, Choudhury, & Campbell, 2009) and their supportive communication style towards visual impaired, illiterate users and children (Ekman, et al., 2005). The human ability to more quickly notice changes in the sonic environment than with our other senses also make audio interfaces a good choice for peripheral context-aware services. Moreover, the inherent emotional and cultural qualities of audio, evoked through music and sounds (e.g., the sound of an old telephone ringing), offer the possibility of visceral responses (Caramiaux, Altavilla, Pobiner, & Tanaka, 2015) (Tahiroglu, Özcan, & Ikonen, 2014) (Rocchesso, et al., 2008).

These apparent advantages of audio-based communication suggest high potentials in both current and future interaction designs (Polotti & Lemaitre, 2013), which brings up further discussion of why sound should be considered a more fundamental part of the interaction design practise and study (Tahiroglu, Özcan, & Ikonen, 2014) (Franinovic & Serafin, Introduction, 2013). Specifically, the hands- and eyes-free communication mode offered by sound has resulted in growing implementation of sound-driven technologies in applications for mobile and wearable devices; navigational apps (e.g., Blinfo[5]), real-time translation services (e.g., iTranslate[6]), personal coaches in mobile fitness applications (e.g., Moov[7]) and in-car speech systems[8] are just some of the mobile services that have applied audio to facilitate mobility. More recently, a new category of audio-based wearables, called *hearables*, have entered the market and are predicted to become a standard technology in the future (Bødker, 2017) (Hargrave, 2017). Designed as small in-ear headphones and driven by artificial intelligence (AI), hearables move the activity of listening to a whole new experiential level. By exploiting the technological knowledge found in hearing aids, new

[1] https://www.apple.com/ios/siri/
[2] https://www.theguardian.com/technology/2017/feb/07/amazon-alexa-car-logitech-zerotouch-voice-services-assistant
[3] https://www.theguardian.com/technology/2016/may/18/google-home-assistant-amazon-echo-apple-siri
[4] https://www.theguardian.com/technology/2017/dec/11/apple-buys-shazam-music-app
[5] https://www.tv2lorry.dk/artikel/blindecenter-udvikler-revolutionerende-info-system
[6] https://www.theverge.com/2017/8/3/16076084/itranslate-app-real-time-translation
[7] https://www.theverge.com/2014/2/27/5453338/moov-siri-coach-personal-trainer
[8] https://www.globalme.net/blog/the-present-and-future-of-in-car-speech-recognition

design strategies and concepts such as *active listening*, *smart listening*, and *audio-augmented reality* have emerged, and the design idea behind these new audio-mediating devices is to empower the user with a greater control over their sonic environment through filtering, manipulation or extraction (Elgan, 2015) (Shivakumar, 2016) (Robertson, 2018).

These new design strategies indicate the sophisticated acoustic spaces designers might find themselves in future technologies, and thus the importance of understanding auditory user experiences from a more fundamental and holistic position.

Even though sound has been a part of the digital user interface throughout the history of computing - from the beeping digital sounds in the early 1960s terminal computers to background music in mobile applications - only a few formal resources exist on how to understand and examine user experiences within audio-based interactions (Frauenberger, Stockman, & Bourguet, 2007) (Lumsden, Brewster, & Gray, 2002) (Tahiroglu, Özcan, & Ikonen, 2014). Lumsden, Brewster & Gray (2002) did a survey among interaction designers that revealed very limited knowledge of the intrinsic value and materiality of sound, indicating a need for guiding principles on how sound could or should be understood. Designers do know the importance of knowing how design is affecting the end-user. How can a designer create audio-based interfaces that support the listener in an intended way, without any knowledge of how we as human direct ourselves towards auditory phenomena? Besides, how can interaction designers develop strategies, concepts and principles, and evaluate auditory interaction designs without knowledge and vocabulary for what constitutes human auditory experiences? As stated by the Canadian composer, R. Murray Schafer:

> "[…] in order to communicate a sensation, you must have a rod to describe it." (Schafer R. M., 2005, s. xvi)

Despite the increasing engagement of our hearing sense in the design of interactive products, very little attention is given to creating a fundamental understanding of the nature of auditory user experiences within interaction design, an understanding that takes a holistic approach. When designing or evaluating audio-based interfaces, the way in which our experiential system works is rarely considered; the majority of inquiries into audio interaction design within HCI and Interaction

Design often neglect the complex experiential processes behind human listening and meaning creation (Tuuri, Mustonen, & Pirhonen, 2007).

In contrast to hearing, listening is traditionally regarded as a selective process based on our activity and internal goals. Thus, auditory phenomena may be experienced in many different ways, depending on our focus, intention, context, as well as previous experiences with the sound or situation in which the sound occurred. For instance, when listening to a musical piece, one listener might focus on the music being too loud if he or she dislikes the song; another listener might attend to the instruments being played in the song; the emotions of the song might capture yet another listener. As we see, enquiring into the experiences of hearing this song might result in three completely different and seemingly unrelated responses. Moreover, if the same enquiry is made one year later, three very different answers might be the result.

One way to overcome this lack of a holistic experiential platform for discussing, analysing and evaluating auditory user experiences, will be to apply philosophical reflections to the concept of auditory experiences. Addressing auditory experience from a philosophical position offers an alternative way to address experiences from a listener's perspective. With greater knowledge and understanding of what constitutes auditory experiences, interaction designers will become better equipped to describe, analyse and evaluate experiential qualities of audio-based interfaces, and better at specifying challenges and possible design solutions.

In the last five decades, scholars within fields such as sound studies and musicology have made rich contributions to portray auditory experiences in philosophical ways, but their insights have not been influential enough to affect interaction design research and practices (Franinovic & Serafin, Introduction, 2013).

The research in the present dissertation contributes to knowledge creation in interaction design research by proposing a new theoretical foundation for communicating, analysing and evaluating auditory user experiences, by approaching auditory experiences from a holistic position through a phenomenological lens.

Turning towards the hearing aid industry in the case study seems to be an appropriate when investigating auditory user experiences, not just because of the current emanating interest in the hearing aid technology, but more importantly because the experiential qualities in wearing hearing aids have a tremendous impact on the user’s overall well-being (Dahl & Hanssen, 2016), as well as

on their cognitive functioning[9]. Today, many companies in the health care service sector struggle to find a way to improve customer experiences with their services or products (Bate & Robert, 2007) (Rutkowska, Lamas, Visser, Wodyk, & Benka, 2017), and the hearing aid industry is no exception. Hearing deficiency is one of the most common chronic health conditions today, and hearing aids are the most common form of treatment for a person with age-related hearing loss. Every year audiological consultations in Denmark tune more than 70.000 hearing aids, and 37 million Europeans that is every 6th European citizen are estimated to have hearing problems[10]. Hearing aid manufacturers are much concerned with the quality of their users' auditory experiences. This concern is not just a matter of adding extra value to their services and products in a highly competitive environment, but also caused by the high dropout rates found among hearing aid users[11]. Hearing is a complex matter, and hearing loss seems even more complicated. Firstly, hearing loss happens on different frequencies, which demands highly advanced technology in the hearing aids in order to automatically compute what frequencies to enhance and decrease. Secondly, similar physiological deficiencies can result in very different listening experiences, which cannot be explained through audiograms[12]. Having taken full advantage of computational possibilities in current hearing aid technologies, understanding experiential values that go beyond current threshold measurements and psychoacoustic evaluations seems to be the only area in which further enhancements can be applied.

Research question and objectives

The aim of this thesis is to create a theoretically grounded framework that describes auditory experiences through an interpretive understanding of human experiences. Through explorative studies of auditory experiences from a phenomenological perspective, the intention is to create a theoretical foundation for describing and evaluating auditory user experiences.

[9] http://www.videnscenterfordemens.dk/forskning/forskningsnyheder/2017/03/nedsat-hoerelse-knyttet-til-kognitiv-svaekkelse-i-alderdommen/
[10] http://www.hoerelse.info/hver-sjette-dansker-horer-darligt
[11] https://www.fyens.dk/indland/Hver-ottende-hoereapparat-samler-stoev-i-skuffen/artikel/3221317
[12] Taken from interviews with audiologists in the case study.

The framework should facilitate designers in describing, evaluating and analysing auditory user experiences, and its applicability and practicability would be investigated through empirical explorations.

The overall research question that is answered in this project can be summarised as:

> *Which theoretical and practical approaches can be applied to develop a tool that facilitates user experience designers in describing and evaluating auditory user experiences from an interpretive and holistic perspective?*

In order to answer the research question, a philosophical, well-defined standard of what constitutes experiences is vital.

With the ultimate goal of creating a theoretically grounded model for describing, evaluating and analysing auditory experiences that are equally applicable in practical and research-oriented settings, the objectives of this thesis include:

- Framing experience from a well-established philosophical tradition,
- Constructing a theoretically grounded terminology relevant for auditory experiences based on the philosophical framing of experience, and
- Utilising the the terminology and philosophical concepts in a design tool.
- Explore the applicability of the design tool empirically.

Thus, the framework should be considered as a design tool that allows interaction designs and researchers who work with auditory interfaces to analyse and evaluate experiential qualities in auditory interaction design.

Scope of the project

Even though the focus in this dissertation is on the auditory aspect of user experiences, it is not my claim that we can investigate auditory experiences isolated from other sense modules. According to the phenomenological ontology, *experience* is an engagement of all senses, but for the scope of this project, the focus will be on experiences made through listening.

Moreover, this is not a project about acoustic environments, acoustic qualities or sonic effects, but about describing the auditory experience as structural processes in the body and the mind in a way that can facilitate a design process. Thus, the result will not be in the form of normative design guidelines, a categorising of sounds, definitions of the sonic environments, or a model that prescriptively explains causal relationships between sound and human behaviour. Instead, the intention is to understand how we experience through listening and how this understanding can be transformed into a structure that can be applied in design settings.

Contributions

Compelled by Thackara's (2001) Compelled by Carl's call for revising and developing new theoretical, analytical and practical design tools in order to better understand the interplay between humans and technology, this thesis contributes to the field of HCI and Interaction Design in the following ways:

1. It overcomes the shortcomings of current approaches towards auditory user experiences by providing a design tool for holistically describing auditory user experiences. Its phenomenological meta-theoretical rooting makes it independent of any methodologies. Regardless of the chosen design methodology, the model can be applied as a guiding basis.

2. The descriptive nature of the model makes it suitable as a framework for describing and discussing auditory user experiences, no matter whether the focus is on psychoacoustic, aesthetical, or physiological experiences.

Consequently, the overall contribution to the ongoing work of knowledge construction in HCI and Interaction Design can be summarized as proposing a philosophical, grounded, methodological-independent design tool for investigating auditory user experiences. I hope this tool will cause user experience designers and researchers to reflect on the complex structures behind auditory user experiences, and equally importantly, promote a greater focus on non-visual experiential qualities in the interaction design community.

Structure of the Thesis

The structure of the project does not describe the actual sequence behind my inquiry into the research topic: an initial research question and hypothesis, followed by literature reviews that lead to a thesis to be tested empirically. In reality, the research process was guided by explorations into how a phenomenological understanding of experiences can support and guide a design process, resulting in a research question that was not specified before in the final part of the project, due to this inductive approach. Many initial ideas and strategies had to be revised or abandoned during the process, and many new ones led me in fruitless directions. Moreover, empirical explorations were conducted next to the philosophical explorations in a hermeneutic manner and findings from the empirical explorations fed into the philosophical explorations and vice versa. Thus, my research was far from a straightforward process.

In my initial inquiry into how user experiences can be described within auditory interaction design, I was hampered continuously by two concepts that were not easily framed, but crucial for moving forward. These were the *concept of auditory experience* and the *concept of listening*. I found these two concepts crucial to this project, as well as highly depended on each other: How can one talk about an auditory experience with no knowledge of human listening, and how can one talk about listening with no clear definition of what constitutes human experiences? These two concepts, and their relation to each other and audio interaction design, are therefore treated separately in two chapters (chapter 4 and 5). The creation of these two chapters was based on a continual process of reading and interpreting the philosophical underpinnings of experience and its relation to the act of listening, and the way these explorations unfolded in the two chapters were a highly influential factor in setting the overall direction of my research.

Presenting the research design in the following block-like manner is only done to provide the reader with a comprehensible reference to the thinking and methodological choices behind an otherwise "messy" project.

Chapter 1 serves as a general introduction to the research topics and direction of the dissertation, and the research contributions are being specified. In this chapter, a description of the background, motivation, research context, research question and research objectives are presented.

Chapter 2 outlines the theoretical framework and methodological structure that guides the dissertation, and my empirical research is presented. Since my project was shaped gradually throughout the entire period of the PhD programme, the methodological choices described in this chapter were made in a progressive and pragmatic manner.

Chapter 3 provides a brief presentation of HCI and Interaction Design and outlines some key characteristics of auditory interaction design, as well as clarifying its understanding and use of the concept of user experience.

Chapter 4 explores and discusses the concept of auditory experiences from a philosophical point of view, centring on phenomenology and its key theme of intentionality. A preliminary outline for the design tool is created based on a phenomenological vocabulary, and phenomenological descriptions that are relevant for inquiries into auditory user experiences are selected.

In **chapter 5,** the findings from chapter 4 are synthesised with philosophical reading on the concept of listening offered by seminal theorists within musicology.

Based on the philosophical findings from chapter 4 and 5, **chapter 6** presents a preliminary outline of the model that explains auditory user experiences from a holistic perspective.

Chapter 7 presents the empirical research process and the main findings.

The findings from the philosophical and empirical explorations are synthesised and discussed in **chapters 8**, and the final model is subsequently presented.

Chapter 9 presents the overall conclusion, and future research is suggested.

2. Research design - methodology

> *"This, it seems to me, is the challenge for design research, to help construct a way of conversing about design that is at the same time both interdisciplinary and disciplined. We do not want conversations that fail to connect across disciplines, that fail to reach common understanding, and that fail to create new knowledge and perceptions of design."*
>
> (Cross, 1999)

How new knowledge is produced within research is highly dependent on the theoretical and methodological choices that are made in the process. This makes ontological and epistemological positioning a vital part of a research inquiry. The meta-theoretical foundation of this project draws from a phenomenological and a pragmatist philosophy: a phenomenological view on experience and a pragmatic view on the research design and design thinking.

The methodological approach in this research can be characterised as inductive, as my research question gradually was refined by the philosophical and empirical explorations throughout the research process. I did not start with a clear hypothesis or research design. I started in unfamiliar terrain with curiosity as my only guide.

Within the HCI and Interaction Design community, design research is often referred to as the informing of the product development process, whereas design research communities refer to an inquiry that contributes to knowledge production. The convention of this thesis belongs to the latter definition.

This chapter opens with an explanation of the epistemological positioning of the project and the methodological approach.

Design research and knowledge production

Bærenholdt et al. (2010, s. 10) propose three different relationships between design and research: research *for* design, research *into* design, and research *through* design (including design *through* research). Research *for* design is design informed by investigation of the object in the form of the involved materials, mechanics, and functions. This approach is the most traditional approach and with its functionalistic methodology seeks universal answers to design problems. It has strong ties to design science, where the attempt is to build systematic knowledge applicable to design. The economist and Nobel Prize winner Herbert Simon's *The Science of the Artificial* from 1969 is fundamental reading within this approach and was the most cited resource within modern design literature from 1990 to 2000[13]. The design-research relationship in this tradition is often instrumental, and qualitative approaches are usually ethnographically informed (e.g., Computer-Supported Cooperative Work). For Bærenholdt et al. it is not enough to present research knowledge before design; the result will be improved if research is actively involved in the design process. In the 1980s and 1990s, a new approach to design emerged, where an interest in the design processes became the research agenda. They label this research concerning the studying and analysing of how design is carried out as *research into design* or *science of design* (2010, s. 3). The third approach, *research through design – design through research,* mentioned by Bærenholdt et al., moves away from this dualistic view on design and research, where design and research are seen as separated entities. The third approach, which is also known as *design-based* research, views design and research as interconnected entities continually informing each other (2010, s. 2-4). Bærenholdt et al. also make a distinction between *foreground knowledge*, which relates to design knowledge that is directly applicable in a design process, and background knowledge that is theoretical explanations of design problems. Intending to create a design tool that is theoretically founded and can be practically applied in the design process, this present research concerns both foreground and background knowledge. Thus, in Bærenholdt et al.'s technical terms, the type of knowledge this research project produces is a *foreground-background knowledge* produced through *research for design*. It differs from Herbert Simon's rationalistic approach, though, by taking on an interpretive

[13] For a long period *The Sciences of the Artificial* was considered a seminal text for all design theorists and researchers.

perspective in the theoretical explanations. In the 1950s and 1960s, rationalism was the dominant approach within design research, with Herbert Simon as one of the most influential design researchers at that time. This approach focuses on the description of the natural world and the rationalities that govern humans, not taking the human and artistic views into account. It founds the design process on logic, rationality, abstraction and rigorous principles, where design is prescribed through orderly procedures and systematic data collection transferred into clear objectives and design solutions (Koskinen, Zimmerman, Binder, Redström, & Wensveen, 2011, s. 15). The phenomenologist, Hubert Dreyfus (1929-2017), used Artificial Intelligence (AI) to question this rationalistic approach in his seminal book "What computers can't do" from 1972 (Dreyfus, 1972): despite their excellence in calculations, the most sophisticated computers are far behind a child's capability of speaking and recognising objects. There were also critics of the rational thought coming from the social sciences and humanities within the field of human-computer research. For instance, Lucy Suchman argued for situated design based on her observation of people handling copy machines, where it was demonstrated that rationality has little to do with how people actually use these machines (Suchman, 1987).

A theoretical approach implies that theories should guide design, which is seldom the case. For instance, Bill Schneiderman's theoretical explanation for the popularity of direct manipulation (the use of a mouse instead of the previous command line interaction) came 20 years after the invention of the mouse (Schneiderman, 1984). For this reason, interaction design researchers turned away from cognitive psychology and to post-Cartesian thinking that encourage explorations rather than predictions, and where theory comes after the design. These philosophies are phenomenology, pragmatism, interactionism, and avant-garde art. (Koskinen, Zimmerman, Binder, Redström, & Wensveen, 2011, s. 109-110). The late professor and leader of the Designing Quality Interaction research group, Kees Overbeeke (1952-2011), believed that design researchers were too focused on cognitive skills. His turned to ecological and pragmatic psychology with interest in the emotional, perceptual and social behaviour (Overbeeke, 2007). According to Overbeeke, researchers have grown disillusioned with studying people as mechanics that can be manipulated and measured.

A pragmatic epistemology

In practice, designers rarely follow methodologies and doing design in prescriptive manners does not work.

> "Discontent with this [rationalistic] approach is widespread and quite old, even though no substantive replacement has yet been proposed. Experiences from design practice and the studies of authentic design processes has consistently been that not only don't designers work as design methodologies says they should, it also a well-established fact that to do design in the prescribed manner just doesn't work" (Koskinen, Zimmerman, Binder, Redström, & Wensveen, 2011, s. 15-16).

Thus, a design tool should not be normative or prescriptive but be flexible to work in different design situations and be open to the use of different data collection methods.

For pragmatists, knowledge will always be locally situated and never universal. Knowledge is dynamic and contextual-depended, and knowledge creation is primarily a matter of adding new perspectives and altering existing ones to fit the desired outcome better rather than uncovering universal truths. As this thesis subscribes to this stance, it aims to construct a tool that supports subjective articulations and diverse empirical inquiries, a tool that allows context-depended and local knowledge creation, a tool that seeks to specify the investigated phenomenon and a theoretically grounded tool that always will be open to revision and changes.

The horizon

The phenomenological demand for a reflection of how background and pre-understandings (horizons) implicate the interpretation process also applies for pragmatists.

According to the German philosopher of Hermeneutics Hans Georg Gadamer, the horizon is in a continual process of being formed in our engagement with the external world on various levels, and through this engagement, meaning and understanding materialise.

> "The horizon is the range of vision that includes everything that can be seen from a particular vantage point. Applying this to the thinking mind, we speak of the narrowness of

> horizon, of the possible expansion of horizon, of the opening up of new horizons, and so forth. Since Nietzsche and Husserl, the word has been used in philosophy to characterise the way in which thought is tied to its finite determinacy, and the way one's range of vision is gradually expanded." (Gadamer, 2004, s. 301)

The concept of the horizon is not limited to subjects, but also includes objects. *Thus, u*nderstanding and knowledge are inter-subjective and inter-objective; they are created in relation to others and the physical/material world. (Wind, 2016, s. 23-24)

It is my conviction that my non-acoustic background and interest in a philosophical perspective of interaction design affect my horizon, and thereby have a significant influence on the whole inquiry process. However, suppressing my biographical and cultural context is not desired, and not even possible, which will be explained through the father of phenomenology Edmund Husserl's concept of natural attitude in chapter 4. Instead, reflections and transparency are the strategic tools for qualifying the knowledge being produced. (Wind, 2016, s. 23).

From epistemology to methodology

In practice, designers rarely follow methodologies and doing design in prescriptive manners does not work.

> “Discontent with this [red. rationalistic] approach is widespread and quite old, even though no substantive replacement has yet been proposed. Experiences from design practice and the studies of authentic design processes has consistently been that not only don’t designers work as design methodologies says they should, it also a well-established fact that to do design in the prescribed manner just doesn’t work” (Koskinen, Zimmerman, Binder, Redström, & Wensveen, 2011, s. 15-16).

The proposed design tool should, therefore, not be normative or prescriptive, but be flexible to work in different design situations and be open to the use of different data collection methods.

For pragmatists, knowledge will always be locally situated and never universal. Knowledge is dynamic and contextual-depended, and knowledge creation is primarily a matter of adding new perspectives and altering existing ones to better fit the desired outcome rather than uncovering universal truths. As this thesis subscribes to this stance, the ambition is to construct a tool that supports subjective articulations and diverse empirical inquiries, a tool that allows context-depended and local knowledge creation, a tool that seeks to nuancing the investigated phenomenon and a theoretically grounded tool that always will be open to revision and changes.

The research design

The final research question and hypotheses that are related to the subject area were drawn from my inquiry into theoretical concepts and understandings relating to human perception and experiencing.

My approach is both analytic and descriptive, with the two modes cross-fertilising each other throughout the research process. My research is fundamentally inductive and explorative, and the outcome from the philosophical inquiry has directed the overall focus and determined the topics to be included in the final evaluation tool. Literature reviews of how user experiences are understood within HCI and Interaction Design in general, and in auditory interaction design in particular, were carried out to identify the current philosophical approaches to user experience. The general research strategy could be explained by developing relevant hypotheses and propositions for further inquiries based on philosophical explorations.

Since the objective of the project is to translate the philosophical concepts into a practical design tool, empirical research was employed to investigate the applicability of the model.

Empirical investigations

Since the current dissertation is first and foremost a philosophical-oriented design project, the empirical material is primary, the metatheoretical texts found in the field of transcendental phenomenology that explore the experiential ontology.

Philosophies from the pragmatic tradition are included to transform the phenomenological concepts into a practical tool that can be applied by practitioners and researchers in a design process.

In this project, I collaborated with one of the world's leading hearing aid manufacturer, and because of the confidential nature of the data used in this thesis, the company will only be referred to in general terms or as [company name]. In chapter 7, a case of video diaries made by test users of [the company], who describe their experiences with a new type of hearing aids, is included to explore the suitability of the model as an analytic tool in a design process.

Conversations with audiologists and senior UX experience designers have been made throughout the collaboration period to identify the topics they find challenging, and we reviewed the research findings during this period.

The different sketches of the model were evaluated by two UX designers, a UX researcher, Research Engineer and an Innovation Manager from the Bang & Olufsen, Brüel & Kjær Sound and Vibration Measurement and Moodagent. This evaluation-sessions are also presented in chapter 7.

The intention of the empirical explorations is not to suggest specific methods for collecting data or specific ways to evaluate and analyse designs. As a consequence, inquiries into the validity of the experiential narratives or discussions on data collecting methods will not be carried out in the current thesis. The focus is solely on how first-person auditory user experiences can be explained and organised in a way that will facilitate designer practitioners and researchers, no matter whether they are analysing, evaluating or just describing auditory user experiences.

Investigating auditory experiences concerning hearing aid users is an interesting case to work with for many different reasons: Firstly, the hearing aid industry is very dominated by a scientific and engineering approach, which was expressed by not only the UX designers at [the company], but also by the audiologists at [the company]. In the engineering approach, user experiences are often defined narrowly through threshold and usability measurements, and user experience tests are rarely conducted outside the laboratory. Thus, applying a more holistic view on auditory user experiences has the potential of advancing the current research practices found within the hearing aid manufacturing field. Secondly, the hearing aid industry often experiences a clash between different listening attitudes in hearing aid fitting situations (between the user and the audiologist) and in design situations (between the different stakeholders involved in the design process such as audiologists, users, designers, and developers), where an overview of different listening approaches, and a common platform for discussing auditory user experiences, might help overcome some of the conversational difficulties. Thirdly, for hearing aid users, auditory experiences with their hearing

aids are crucial for their overall well-being, since hearing aids are tools that are meant to be used all day long, and eventually become a natural part of the body. Thus, uncorrected hearing loss and wrongly corrected hearing aids impede the social life of the users, since the experienced inferior communicative abilities may create fatigue and social isolation, which could lead to depression (Arlinger, 2003). A study from 2007 by Sergei Kochkin, Executive Director of the Better Hearing Institute in Washington DC, showed that only one in five adults in America with documented hearing loss are using hearing aids, making it around 22 million adults with admitted hearing loss who avoid the use of hearing aids (Kochkin, 2007). Being afraid of the stigma, not feeling that the hearing loss is profound enough (this includes people with a profound hearing loss), and the cost of hearing aids, were some of the reason for not using hearing aids. However, 68% of the respondents indicated that negative auditory experiences with hearing aids as their reason for returning the hearing aids or leaving them in the drawer (Kochkin, 2007, s. 39-40).

The design tool

An experiential framework is created from the Husserl's transcendental phenomenology and Merleau-Ponty's body-oriented phenomenological approach. The findings are synthesised with interpretive research into listening practice found within musicology. In particular, the French composer Pierre Schaeffer, the film theorist and composer Michel Chion, the German music theorist Helmut Rösing and the Swedish professor in music research Ola Stockfelt's theoretical approach to listening will be brought into the discussion. Through a pragmatic epistemology, the philosophical concepts are translated into a model that is then evaluated empirically.

3. HCI, Interaction Design, and user experience

> *"The more our everyday experiences are mediated through interactive technology, the more they become a matter for design."* (McCarthy & Wright, 2004)

This chapter opens with a short introduction to Interaction design and Human-Computer Interaction (HCI) and after that addresses the concept of user experience using phenomenology as an ontological frame in combination with a pragmatic design thinking.

Experiential understanding is considered as the departing point of any inquiries into the quality assessment of interaction design, where the felt intensity of an experience is a way to measure these qualities.

Human-computer Interaction and Interaction Design

The field of Human-Computer Interaction (HCI) grew out of a collaboration between the disciplines of computer science and psychology, with strong roots in engineering and behaviour science.

Partly grown out of HCI and partly out of design fields such as Graphical Design, Interaction Design (ID), on the other hand, is rooted in phenomenological and pragmatic thinking with a strong focus on user experience (Preece, Rogers, & Sharp, 2015, s. 8-10). Jonas Löwgren, a Swedish professor in Interaction and Information Design, finds that far too many people relabel HCI as Interaction Design without changing this engineering approach (Löwgren, 2002). According to Löwgren, there is no agreed-upon definition of Interaction Design. However, a common understanding is that Interaction Design is more focused on the design aspect of digital devices than HCI. Moreover, Interaction Design suggests a broader technological scope that not only includes computers, but all kind of interactive technologies (Preece, Rogers, & Sharp, 2015, s. 9-10) (Preece, Rogers, & Sharp, 2015, s. 9-10).

Daniel Fallman, professor of Human-Computer Interaction and User Experience Expert, incorporates Löwgrens notion of Interaction Design in his definition of HCI by stating that HCI has emerged as a design-oriented field of research:

> "Human-Computer Interaction (HCI) is the research discipline concerned with the design, evaluation, and implementation of interactive computing systems—and in particular the phenomena that surround human use and experience of such technology." (Fallman, 2007, s. 193)

HCI's evolvement from a conservative account of design as an engineering endeavour, theoretically and methodologically grounded in rationalism, into a more interpretive perspective materialised in concepts as user experience is also acknowledged by the authors behind the seminal book "Interaction Design – beyond human-computer interaction":

> "Also, historically, HCI was concerned primarily with usability (known as usability engineering) but has since become concerned with understanding, designing for, and evaluating a wider range of user experience aspects" (Preece, Rogers, & Sharp, 2015, s. 19)

The different views and definitions of both HCI and Interaction Design make drawing a line between these two notions a delicate task. For that reason, it is necessary to emphasise that when I turn to HCI in the thesis, my focus is on its design and user-experiential orientation.

The concept of user experience

For a long time, computer science was more comfortable with the laboratory than the outside world, and they were more directed toward functional accounts of computers and human activity than towards experiences, but an interest in the user that exists in both HCI and Interaction Design is far from new.

During the 1970s and 1980s, information-processing psychology was the dominant approach in defining the relationship between a user and the computer. The conventional picture drawn of this relationship was a single user sitting in front of a single computer communicating through a keyboard and screen performing prescribed, work-related tasks. Even though a user-centred approach originated in the early 1980s in companies such as IBM and Digital Equipment Corporation, it did not become a common design strategy until the 1990s, when the (potential) users became an inspirational source in the design process, and the concept of usability emerged from disciplinary fields such as ergonomics, practical engineering, and cognitive psychology. Hi-tech companies, as well as universities, implemented usability laboratories, and usability guidelines outlined by Jakob Nielsen's Usability Engineering |, which dominated the practical and the academic curriculum in the 1990s (Koskinen, Zimmerman, Binder, Redström, & Wensveen, 2011, s. 19-22). Still, usability did little to inform design about contextual and experiential issues related to the human-computer interaction.

In the late 1980s and the 1990s, a more profound interest in experiential qualities slowly moved into the scene of HCI through disciplines such as cognitive science, anthropology, sociology, semiotics, phenomenology and pragmatism, changing the discourse to also include social and cultural contexts (i.e., thoughts, values, feelings, and culture, and historical background) from which the human-computer interaction cannot be separated. However, even though HCI decided to address the user since the mid-1980s, there has been a resistance to talking about subjective experiences, where objective, measurable inquiries were seen as the basis for advancing theory and practices.

Cognitive psychology was the first theoretical approach to HCI that had a focus on human experiences. In the early HCI, user experience was described as a Human Processor Model (HPM). The Human Model Processor (HMP) presented by Stu Card, T. P. Moran and A. Newell in 1983 (Card, Moran, & Newell, 1983), was one of the earliest theoretical thoughts of experiential processes within HCI. The HPM is a predictive model on human cognition psychology that views people as information processing machines, only constrained by our sensing and motor abilities

.

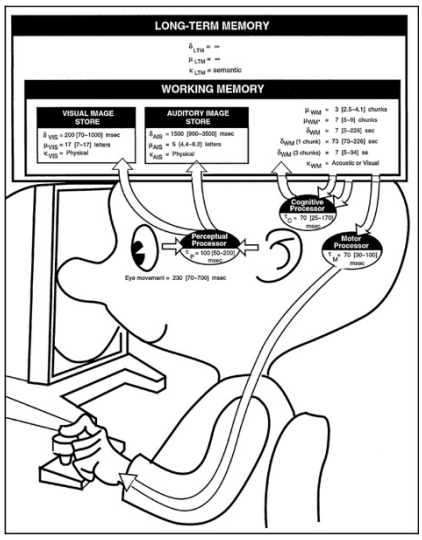

Figure 1: The Human Processor Model (HPM)

The HPM was one of the earliest attempts to uncover human experience in HCI, but as we see in figure 1[14], this theoretical approach only focuses on physical functions and computer-like information processing.

The psychologist Donald Norman is one of the later researchers within HCI that applied the cognitive approach. He extended the cognitive psychological understanding with James Gibson's ecological perceptual theory in his seminal book "The Psychology of Everyday Things" (Norman, 2002). His goal- and action-driven approach took the theoretical understanding of the user beyond the HPM approach through concepts such as affordance and mental models. Norman's definition of affordance is:

> "...affordance refers to the perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used [...] affordances result from the mental interpretation of things, based on our past knowledge and experience applied to our perception of the things around us." (Norman, 2002, s. 9, 219)

[14] The picture of the HPM is kindly borrowed from the book “Interaction design: Beyond human-computer interaction” (Preece, Rogers, & Sharp, 2015, s. 90).

Even though Norman's definition of *affordance* was inspired by James Gibson's equivalent term introduced in 1966 (Gibson, 1966), it differs in that Norman saw *affordance* as a combination of perceived and actual properties of an object, whereas Gibson saw affordance as an object's intrinsic values that the subject may or may not capture.

The *mental model* is another important, and often utilised concept that Norman introduced to HCI design and research. The term is derived from Psychology and defines the image (representation) of the world that people carry in their mind, which in the HCI context translates to mental images of technological functionalities. This concept is defined and used in various ways and situations, but with the common understanding of the notion is it being a cognitive abstraction of the mind (Staggers & Norcio, 1993). Ergo, the definition of *mental models* can be paralleled to the Kantian intellectual understanding of mental processes, whereas the concept of *affordance* links the subject with the object.

With Norman's introduction of cognitive psychology to HCI, human perception is no longer just a matter of sensory input processed through simple cognitive computations, but now included a more sophisticated understanding of the outside world.

Alongside the widespread of digital devices and internet technology, the computer grew into a consumer product and the user into a consumer. Branding and a greater focus on the aesthetical design developed a keener interest in user experience. However, the orientation towards user experience is often highly business- and technology-driven, claiming that technology and branding govern user experience (source).

Terry Winograd and Fernando Flores were the first to challenge the cognitive psychological approach that dominated HCI in the 1980s, through their phenomenological and hermeneutic approach (Winograd & Flores, 1986). They introduced the field of Interaction Design based on the phenomenological philosophy of Martin Heidegger, Humberto Maturana and John Langshaw Austin. Other directions within HCI inspired by Heidegger's phenomenological tool-based approach, were ethnomethodology and Activity Theory. Lucy Suchman introduced *ethnomethodology* in her seminal book "Plans and situated actions, the problem of human-machine communication" from 1987 (Suchman, 1987), and Liam Bannon and Susanne Bødker (Bannon & Bødker, 1991) introduced Activity Theory to HCI.

Professor Dag Svanæs, a researcher within the phenomenological stance of HCI and Interaction Design, applies the embodied phenomenology of the French philosopher Maurice Merleau-Ponty (1908-1961) in his research into interactivity (Svanæs, 1999), (2013).

The computer scientist Paul Dourish also applied phenomenological thinking to explain embodied interactions through tangible computing, drawing from not only Heidegger and Merleau-Ponty but also from Edmund Husserl (1859-1938) and Franz Brentano's concept of intentionality (Dourish, 2004). Typical for these phenomenological approaches to HCI and Interaction Design, are their use of phenomenology to describe the human's tool-based and bodily being in the world, with little or no explanation of possible experiential structures of mental acts.

However, Paul Dourish was not only inspired by the philosophical tradition of phenomenology but was also motivated by pragmatism in his focus on tangible and social computing. Through his pragmatic and phenomenological lens, Paul Dourish described *experience* as a phenomenon to be studied in its own right and defined the physical presence in the world, social practices and purposes as influential factors (Dourish, 2004, s. 21). Lived, felt and emotional experiences were now placed before functionality, efficiency and ease of use when referring to user experience (Desmet & Hekkert, 2007) (Hassenzahl, 2010) (McCarthy & Wright, 2004, s. 5).

This global shift within HCI of turning away from usability as the only design goal, and towards more holistic definitions of experiences was labelled the third wave by Susanne Bødker (Bødker, 2006). Even though this significant shift towards experiential qualities has been prominent for the last decade, we still encounter very little interest in defining the fundamental structures of experience holistically. Instead, the focus is often on specific areas of experience, such as emotions and bodily experiences. When we consult holistic descriptions of experiences, they are often vaguely described definitions, such as the following ISO standard definition for user experience, where there is no guidance on how to understand and evaluate these experiential components:

> " Person's perceptions and responses resulting from the use and/or anticipated use of a product, system or service […] User experience includes all the users' emotions, beliefs, preferences, perceptions, physical and psychological responses, behaviours and accomplishments that occur before, during and after use […] User experience is a consequence of brand image, presentation, functionality, system performance, interactive

> behaviour and assistive capabilities of the interactive system, the user's internal and physical state resulting from prior experiences, attitudes, skills and personality, and the context of use."[15]

Alternatively, as defined by Preece et al.:

> "[User experience] is about how people feel about a product and their pleasure and satisfaction when using it, looking at it, and opening it. It includes their overall impression of how good it is to use, right down to the sensual effect small details have on them, such as how smoothly a switch rotates or the sound of a click and the touch of a button when pressing it." (Preece, Rogers, & Sharp, 2015, s. 12)

They even stress the importance of understanding the qualities of the user's experience when interacting with digital products or services, but without specifying how to assess these qualities. However, they emphasise usability, functionality, aesthetics, content, the look and feel, and the sensual and emotional appeal as central to user experiences, in agreement with the ISO standard for user experience.

Even if, the concept of user experience is central to HCI and Interaction Design, not many readily applicable unifying theory or framework exists within Interaction Design (Preece, Rogers, & Sharp, 2015). The computer scientists, John McCarthy and Peter Wright are some of the few within the technological field, who have proposed such a framework for structuring, articulating and analysing the different aspects of user experiences related to our engagement with technology. Inspired by concepts such as John Dewey's definition of aesthetic experiences and the relationship between the self and actions and Mikhail Bakhtin's focus on the felt life, John McCarthy & Peter Wright shaped a description of technology-mediated aesthetical experiences and a tool for analysing these experiences in their seminal book "Technology as experience" (McCarthy & Wright, 2004). The pragmatic approach to experience shares many conceptual values with phenomenological approach such as the greater emphasis on felt experience, the focus on the subject's experiences, and the interest in emotional and sensorial experiential qualities, without separating experience from context and situation (McCarthy & Wright, 2004, s. 12-21). In

[15] https://www.iso.org/obp/ui section 2.15

McCarthy & Wright's pragmatic approach to experience, the concern is not on whether the representation of the world is true or false, but on how thinking of new relations between people, technology and design can help improve the design process.

From this position, Wright, Wallace & McCarthy (2008) developed a framework for experiential analysis through the concept of the aesthetics of experiences. In pragmatism, aesthetics refers to a specific felt form of experience that is shaped by the interplay between the object, the user, the context and history. McCarthy and Wright argue for a greater emphasis on felt experience giving emotional and sensory qualities a more prominent position, without separating them the interaction context and situation. The critical questions here are: How does the interaction make you feel? What emotionally and sensorial qualities does the interaction evoke? What is the felt quality of the interaction?

Moreover, a reflection that goes beyond the current interaction situation has to be applied to understand the felt experience thoroughly (McCarthy & Wright, 2004, s. 12-21). Thus, the aesthetical value of experiences is one way to measure the quality of user experiences. In their framework, they view *experience* from four perspectives termed as threads: a *sensual* thread; an *emotional* thread; a *compositional* thread; and a *spatiotemporal* thread (Wright, Wallace, & McCarthy, 2008). The sensual thread concerns the bodily and sensory engagement in the world. The aesthetics of sensual interaction is how the experience is felt through the body. The emotional thread refers to emotional experiences grounded on judgements towards an object or person, as well as technology-mediated interactions. The spatiotemporal thread concerns the sense of temporal and spatial situatedness, as experiences are always influenced by space and time. The compositional thread relates to relational sensing between parts and the whole of an experience, that is, the sense of unity in an experiential narrative structure. The framework is extended with a distinction between different types of experiential engagements, from anticipated to non-reflective engagements, as well as an inclusion of the subject's historical background (Wright, Wallace, & McCarthy, 2008, s. 18:6-18:9).

McCarthy, Wallace and Wright's translation of experiential theoretical thinking into a tool for interaction designers and their definition of user experience qualities as aesthetic experiences, are adopted by this research. According to Wright, Wallace and McCarthy, experience-oriented design should be conducted through empathic thinking, and since every design situation is unique,

principles and guidelines are depending on the situation, resources and purpose. The experiential framework is, therefore, more appropriate as a design tool for reflection rather than a tool that specifies all experiential aspects in detail. Instead of founding experiential reflections on the pragmatic tradition, a phenomenological understanding of experience is applied as the theoretical foundation for my framework, and since the framework focuses on the auditory life of users, felt experiences are considered through an auditory lens.

Even though auditory experience cannot be evaluated separated from other sensorial impacts such as vision, touch and smell, we do need to have an insight into the experiential manifestations of the different senses to fully appreciate and understand the overall nature of experience. A fact acknowledged by McCarthy & Wright:

> "Although it is difficult to divide experience into distinct parts, it is feasible to try to understand what elements constitute an experience, without overlooking the overall context or circumstances that surround it. Of course, it is impossible to draw clear boundaries between the elements because of the holistic nature of experience. What we can do is to group the pieces that are most closely related to each other and regard them as elements and analyse the relationship between the ones who are less closely related. This approach allows us to interpret human experience in a more systematic way and to provide overall experiences for users." (McCarthy & Wright, 2004, s. 24-25)

This practical way of systemising *experiences* has the overall purpose of operationalising highly philosophical concepts so that they can be applied in a design situation.
McCarthy & Wright (2004) also emphasise the importance in grounding the structuring of experiences on well-established theoretical foundations to structure experiential concepts in a meaningful and coherent way, which is done in chapter 4 and 5.

Auditory interaction design

Audio-based interaction design is divided into many different specialised fields. One prominent field within audio-based interaction design is Auditory Display (AD) that specialises in non-speech communication for data representation and system status indication. This research area, inspired by Sara Bly's doctoral dissertation, emerged in 1992 as the International Community for Auditory Display (ICAD). The display, in this case, refers to either loudspeakers or headphones. Transformations of data into digital non-speech sound signals is done through a process called sonification, where data and data relations are transformed into acoustic signals. This way of using sound as a medium for data representation is applied in various fields from physics and acoustics to social science and musicology (Hermann, Hunt, & Neuhoff, 2011) (Vickers, 2012). Examples of sonification methods are audification, parameter mapping and earcons design. Audification refers to the process of making in-audible wave-formed data audible to the human ear from either frequency scaling or a direct translation of the data waveform into audio waveforms. Examples of audificated data are seismographs, bat detectors, modified audio-recordings, and physiological monitoring systems such as auditory EEG[16] monitoring devices (Baier, Hermann, & Stephani, 2017). Another sonification method is to translate the dynamics of non-physical data such as the stock market into sound signals (Hermann, Hunt, & Neuhoff, 2011, s. 301). Parameter mapping is a method where non-wave formed data are presented through acoustic properties such as pitch, loudness, rhythm or timbre. The Geiger counter, Sonars and the auditory display of metal detectors are examples of auditory parameter mappings. Earcons are also a kind of parameter mapping, but where the parameters are short computational events and information, or computational objects, represented through short structured sound patterns such as the notification tone of incoming emails or messages and the use of a jingle to denote the beginning of a specific radio programme.

This thesis is placed in the fairly newly-established field of Sonic Interaction Design (SID). SID emerged in 2013 to challenge the current way of designing sound-producing objects that only have a functional, iconic or signalling role, by researching the potentials in regarding sound as an (inter)active, performative and informative medium capable of providing experiences that goes beyond experiences related to usefulness, efficiency and perceptibility (Franinovic & Serafin, Sonic Interaction Design, 2013, s. vii). SID is an interdisciplinary field that grew out of the research field

[16] EEG or electroencephalography is a method that records the electrical activity in the brain.

of Musical Interaction called New Instruments for Musical Expression (NIME)[17] . Thus, methodologies and concepts within SID are often derived from the sound and music computing communities (Franinovic & Salter, The Experience of Sonic Interaction, 2013, s. 40-41).

SID explores ways of understanding embodiment, experience and meaning-creation in audio-based interaction design through their involvement with different disciplines such as psychology, music research, cognitive science, cultural studies, art, acoustics, interaction design, media- and communication studies, and how this understanding can be translated into design strategies and practices. In SID, sound is viewed as a conveyor of meaning, and contextual concerns such as emotional and bodily actions and reactions are included in the design reflections. Thus, how people evaluate and give meaning to sounds is an important topic in sound design construction. So far, investigations into the relationship between bodily gestures and sound-based communication have been the dominant focus within SID (Franinovic & Serafin, Introduction, 2013), as well as investigations into sound as a conveyor of information (Franinovic & Salter, The Experience of Sonic Interaction, 2013).

According to Franinovic & Serafin (2013, s. x), the field of SID follows the "third wave" of HCI and interaction design, because of their inclusion of culture, emotion, and phenomenological experience. Hence, SID aims at advancing the field of HCI and interaction design through a paradigm change in how we approach audio-based interaction design, and it provides tools and methods for interaction designers and researchers alike. SID is predominantly aiming at explorative and experience-based design, and evaluation principles that go beyond the paradigm of rigid guidelines and acoustical evaluations so often found within sound and music computing:

> "To come closer to reaching such a complex goal, the field of SID, which is in its infancy, must engage with a wide range of research topics including perceptual, cognitive, and emotional study of sonic interactions, improved models for the reception of sound and its role in performance of actions, adapted design methodologies, sound synthesis technologies and their use, and finally, design and evaluation methods addressing the individual and social experience with sounding objects. For a new generation of sound designers to be

[17] NIME is a subgroup of Human-Computer Interaction formed in 2001 intending to create expressive interfaces beyond what is offered by the keyboard and screen. They were the first to apply auditory design principles and methods when designing interactive sonic systems, as opposed to the dominant engineering approach.

> capable of addressing the interdisciplinary problems the field raises, a more solid foundation needs to be developed that can draw on such bodies of knowledge.“ (Franinovic & Serafin, Sonic Interaction Design, 2013, s. xi)

The above objectives of in-depth investigations of auditory perception from an interpretive and philosophical perspective fit very well the objectives of this research. Thus, my proposed framework and model for describing auditory experiences from a broader perspective than solely through psycho-acoustics and usability places this current research as a contributor to the field of sonic interactions. However, my intention is not to devaluate current psycho-acoustical and usability practices, but to present a foundation for the auditory design and knowledge creation that embraces all auditory experiential dimensions on equal terms, and thus acknowledges that a design situation is always unique and the designer and researcher best decide their methodological and strategic choices. Moreover, since experience is the fundament for quality assessment, this work provides an approach for identifying and evaluating experiential use qualities.

To avoid any confusions with the established fields of audio-based interaction design, I will refer to this way of interacting as auditory interaction design.

Imperfective and perfective interaction modes

Inspired by the grammatical terminology found in Linguistics (Zucchi, 1999), I differentiate between to states of interaction, the *perfective* and *imperfective* state, in my experiential approach. Perfective interactions relate to completed interactional events, that is, interactions with clearly defined start and endpoints, whereas imperfective interactions are uncompleted interactional events.

Viewing an interactional experience as either perfective or imperfective is particularly important in the discussion of auditory user experiences, due to the temporal structure of sound. Unlike visual images, meaningful sounds unfold temporally. Immediate listening is therefore predominantly experienced in an imperfective mode, and predominantly described and evaluated retrospectively. It is easier for us to describe our experience of a song after the song is heard, and not while the song is playing - unless we anticipate how the song will unfold or force ourselves to focus on the immediate sounds that reach our ears rather than on the song itself.

Thus, some audio-based interfaces are more straightforward to evaluate than others. For instance, evaluating a notifying sound signal is less complicated than evaluating the experiential

qualities of listening through hearables or headphones, not only because of the duration of the auditory interaction but also because the former has a naturally defined interval (from when the notifying sound starts until it ends). In contrast, the latter has no obvious start and endpoint. We can differentiate between these two types of auditory interfaces by labelling them as the *perfective auditory interface* and the *imperfective auditory interface*, respectively. Evaluating imperfective audio-based interfaces require the creation of fixpoints to which the experience can be centred. These fixpoints can be based on either a significant event (e.g., breakdown occurrences and positive encounters) or context (e.g., specific locations, social settings, specific times).

These two experiential states can be paralleled with John Dewey's differentiation between *experience* and *an experience* in his seminal writing on aesthetical experiences "Art as Experience" (Dewey, 1934). Dewey's distinction specifies the difference between *an experience* that has a clearly defined start and endpoint (*an* experience) and the blurry state of experiencing without a clear start or endpoint. According to Dewey, *an experience* is a complete experience centred around a specific plot, and the more differentiated and well-defined the experience is perceived, the more aesthetical he considers it to be. Since this thesis is centred around the term experience, it is essential to state that the use of the term *experience* is always referring to Dewey's definition of *an experience*.

Virtual and mixed reality

Interactive technology can either be categorised as virtual reality (total submission), mixed reality (a combination of the real and virtual), and reality (no digital mediations) (Fuhrt, 2011, s. 3). Virtual reality is a full submission into a virtual world and includes all kinds of listening, where all external sounds are excluded, designed or manipulated. Headphones are mediators of such auditory virtual realities. Typically, virtual reality is understood through our visual sense, but in this current work, this term is defined through the auditory realm. In VR, an aesthetic quality could be a full submission into the virtual realm that is uninterrupted by sounds from the external physical world, which in this sense will be labelled as noise. Mixed reality is partly real and partly digital, and includes technologies such as hear-through headphones and ambient signalling. Augmented reality, where digital sounds are applied to real sounds, can be considered as is a variation of mixed reality.

Current evaluation practices within auditory interaction design

Too often, within audio interaction design, auditory experiences have been reduced to a series of psychoacoustic factors such as the perception of loudness, pitch, and timbre, usability factors such as efficiency and usefulness, while remaining blind to other experiential values related to embodiment, emotions, meaning-creation and aesthetical appreciations (Västfjäll, 2003) (Franinovic & Serafin, Introduction, 2013) (Zeitler, Ellermeier, & Fastl, 2004) (Asutay, et al., 2012).

Despite the standard agreement within the field of interaction design that experiential qualities go far beyond psychophysical properties and usability, other experiential factors are often ignored or treated loosely in evaluation sessions (Frauenberger, Stockman, & Bourguet, 2007). For instance, no resources to guide evaluations from a human experiential perspective exist within the field of product sound (Özcan, van Egmond, & Jacobs, 2014, s. 97).

Intending to move auditory interaction design beyond its purely functional role, and into a more performative and embodied design thinking, SID places themselves in an interdisciplinary milieu with a focus on bodily interactions, sound as a meaning conveying entity, and the relationship between sound, user and environment. SID finds the typical experimental psychological and psychophysics measurements that are predominantly applied within audio interaction design, as useful only when you look for answers to specific scientific or design problems, which is not a typical condition within design processes that often have a more explorative nature (Rocchesso, Serafin, & Rinott, 2013, s. 127).

Rocchesso, Serafin & Rinott (2013) are some of the few researchers who offer a method for interpretive evaluations of sonic interaction design. Through a method called experimental phenomenology, they argue for joint observations as a way to identify perceptual laws. They claim that exposing a design to a small group of people, who have to agree on the evaluation will result in detailed and stable descriptions.

Giordano, Susini & Bresin (2013) also touch upon how qualitative data can be evaluated. They suggest an examination of informants' listening focus, in order to identify whether their attention is on the sound itself, the source or the symbolic meaning behind the sound. Knowledge related to the listening focus of the informant might reveal important information, such as listening strategies. According to Giordano, Susini & Bresin (2013, s. 170), literature reviews show that people tend to

describe the sound itself when it is generated digitally, and the source or event causing the sound when exposed to natural/real sounds.

Auditory perception and listening play a tiny role in auditory interaction design research (Schwartz, 2003). Despite the centrality of listening in audio interaction design, this chapter shows that research in interaction design currently lacks a comprehensive theoretical foundation for understanding and describing listening and its relation to user experience. Audio designers seldom specify or reflect on how we listen and experience through listening, and, as a result, they ignore the different ways we can direct ourselves to sound phenomena.

Ways of expressing auditory experiences

The scholars Maxime Carron, Franciose Dubois, Nicolas Misdariis, Corinne Talotte and Patrick Susini (Carron, Dubois, Misdariis, Talotte, & Susini, 2014) undertook the challenge of creating a method for articulating auditory experiences. This method was provided through two tools called the *transcription tool* and *Sound Charter*. The idea behind the transcription tool is to facilitate users in articulating auditory experiences in an evaluation process. The transcription tool consists of a deck of physical cards that serves the purpose of creating a shared vocabulary in co-design sessions. The articulated experiences are then used as parameters in a sonificated mood board called the Sound Charter. The Sound Charter consists of cards from a brand identity category and cards from a sound patterns category, with the idea of creating associations between these two types of cards. The cards were organised into *objective concepts* and *subjective concepts*. Objective concepts were sound descriptions belonging to a predefined sonic vocabulary, and subjective concepts are concepts that need to be transcribed into the predefined sonic vocabulary. Participants in this approach were asked to connect the subjective concepts to objective concepts.

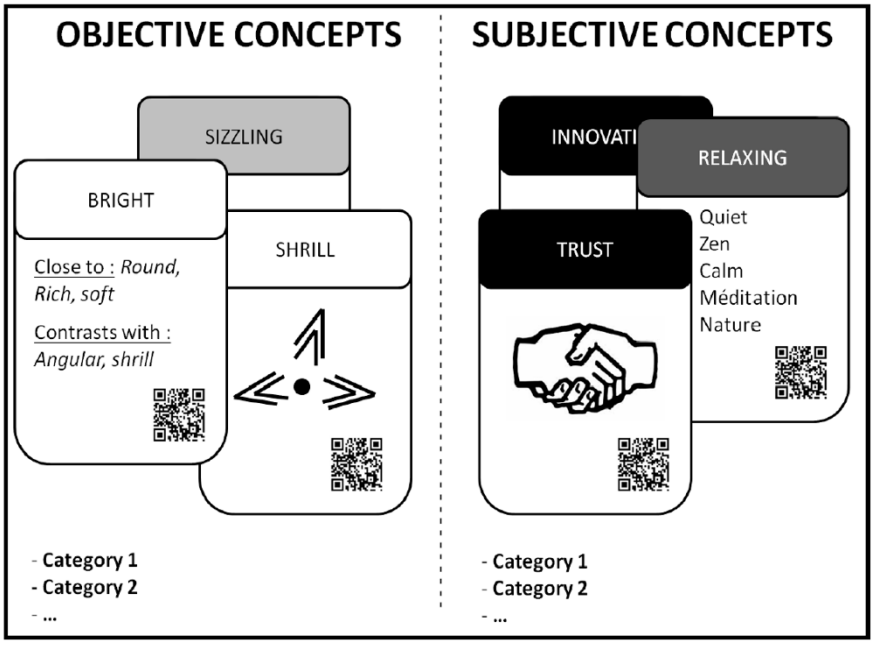

Figure 2: Carron et.al's Sound Charter

The Sound Charter (see figure 2), is inspired by mood boards found within graphical design and function as an extension for the transcription tool. In graphical design, a graphical charter is used to provide product designers requirements in order to ensure that the appearance (shapes and colours) of the product fits the brand identity. Carron et al. chose the mood boards as an inspiration because of their widespread use as a tool for creativeness and communication:

> "Moodboards are an idea development tool used by designers and their clients to communicate, think, and share their different views that emerge from the design brief while defining future products or trends. Although different type of media can be used, they mostly consist of images used in different level of abstraction to tell a story about the company, product or audience, and setting direction for design". (Carron, Dubois, Misdariis, Talotte, & Susini, 2014).

In Carron et al.'s case, sound, images and words were used on their board to illustrate the sound concepts in different ways. Using language to talk about sound is, according to Carron et al. not sufficient. It is like talking about colours. There exists an infinite number of colours, but we are

very limited in our language to describe colours, which also applies to sounds. The output of this method was aimed at the sound and musical designers and acoustic engineers.

The *Sound Wheel* (see figure 3) is another attempt to extend the auditory vocabulary of people with no acoustic or musical background (Pedersen, 2015). The aim of the Sound Wheel is to provide an overview of commonly used words found within acoustic engineering that can facilitate non-acousticians in describing their perceptual listening experiences.

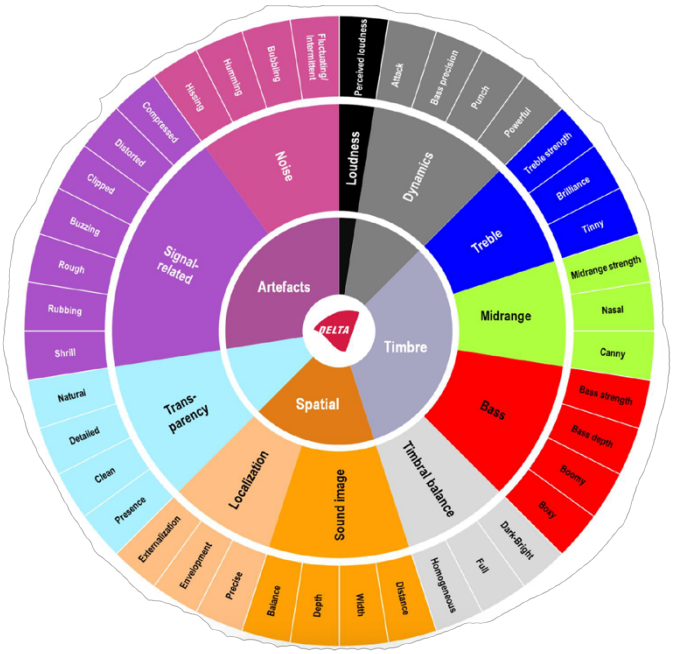

Figure 3: The Sound Wheel by Delta.

Common to these approaches is the aim of creating a vocabulary that specifies what adjectives to use when talking about the experiential perception of acoustic properties. The idea of selecting specific words to be used in an experiential conversation cannot be regarded as phenomenological since this language is created out of a specific attitude towards sounds and sonic experiences. The chosen words and categorisation are the outcome of a certain culture and world view, and thus suppresses other possible perspectives that might, or might not, be crucial for the experiential understanding.

As this section showed, auditory experiential values are often boiled down to psychoacoustic measurements such as perceived loudness and simple semantic quantifications, as well as usability measurements and sound categorisation.

Even though there is a common acceptance to the fact that auditory experiences go well beyond psychoacoustics and usability through experiences related to embodiment, emotions, and aesthetics and socio-cultural relations, the vast majority of auditory products and services are still evaluated without these considerations. Instead, the current practices in evaluating auditory experiences mainly fall into three categories: psychoacoustic measurements, sound categorisation, and usability, where the evaluation of experiences beyond these qualities often are attended arbitrarily and uninformed.

4. I listen, therefore I am

> *"There is no universal approach to listening: every individual, every group, every culture listen in its own way"* (Augoyards & Torgue, 2005, s. 4-5).

This chapter begins with a general introduction to interpretive research and motives for choosing phenomenology as the philosophical line for understanding user experience. Subsequently, fundamental phenomenological concepts and beliefs are presented, concentrating foremost on the Husserl's philosophy and the central phenomenological theme *intentionality*. The ambition is to outline a common phenomenological terminology, based on a phenomenological source (i.e., Husserl's phenomenology) that inspired all later phenomenologists to describe user experience for guiding interpretive evaluating processes within auditory interaction design. Husserl's concepts can promote standardisation of the accounts of researchers and professionals around how to evaluate and analyse evaluations of subjective auditory user experiences.

From an established phenomenological standpoint, auditory experiential evaluations are not just a matter of whether we register auditory messages or not. Instead, by taking a phenomenological approach to auditory experiences, the starting point of my investigations is based on our experiential structures, and how they relate to the external world. For instance, our listening is not only directed towards the sound itself as often assumed but predominantly to the object or event causing the sound, or to abstract meanings conveyed by the sound (Özcan & Egmond, 2005). Understanding auditory experiences cannot, therefore, be understood solely through psychoacoustic appreciations, but must be extended into other experiential dimensions as well.

Another premise of the phenomenology approach is that humans are not sharing a uniform listening experience; rather, they represent a multitude of listening modes, attentions, and meaning ascribed to what is heard. Listening delights frustrates and challenges the listener in various ways. Hence, as the quote initiating this chapter concludes, an underlying condition in a phenomenological approach to listening is that there is no universal way of listening, and as a

result, there is no universal way of experiencing auditory phenomena. Instead, the process of listening is characterised by ambiguity, as it is performed from a uniquely situated position and with a continually changing auditory perceptual field. When we listen to sounds, we approach them in different ways to make sense of what is heard. Not only do we use our prior experience to judge and analyse what we hear, but we also apply different tactics depending on our context and aim in the listening situation.

The fluctuating characteristic of listening is found on both a micro and macro level: micro due to small changes such as moving from one place to another (one sonic territory to another), emotional day-to-day or hour-to-hour changes, and sociality (who we are with); and macro due to significant instances such as life changes (e.g., having kids, moving to a different place) and physical declinations (age-related loss in hearing).

However, does this ambiguity not entail an extreme relativism? Not according to Husserl and other proponents of phenomenology, who claim that the factual presence of the world (i.e., objective reality) is what we have in common and therefore ensures the pitfall of extreme relativism is avoided, as the world cannot be departed.

The phenomenological concepts in this chapter are related to auditory experiences, and the chapter closes with an outline of experiential structures related to the act of listening.

Interpretive research

Interpretivism is a paradigm comprised of different schools of thoughts. The common fundamental assumptions shared by these interpretive philosophical lines are:

- People act on their preferences and beliefs as they interact with the world around them.
- The world can only be investigated through accessing the meanings which participants assign to them.
- The objective reality can never be fully uncovered; we can only uncover how the objective reality appears before the conscious mind.
- There is no direct access to reality unmediated by language and presumptions about the world.

(Klein & Myers, 2001) (Rowlands B. H., 2005).

Interpretive investigations pursue detailed and comprehensive answers to how users experience and make meaning out of their experiences. Interpretive methods are often qualitative in their aim of collecting detailed first-person descriptions. The extensive data production that often follows the interpretive methodology means that interpretive research into user experiences a demanding and complex task to approach. As a consequence, many designers, both in research and industry, who agree on the importance of including subjective, experiential structures of the human nature when evaluating user experiences, often fall back on methods (e.g., quantifiable surveys and response-stimuli experiments) underpinned by a positivistic world view. Thus, applying concepts from interpretive philosophies to create a tool that supports the evaluation of user experiences from an interpretive position is a valuable contribution to the field of interaction design.

A phenomenological approach

Developing a tool that supports interpretive investigations of user experiences requires a philosophical foundation that takes its starting point in an interpretive understanding of the experiential structures of the human mind. For phenomenology, the experience is the departing point of any scientific and philosophical inquiries and therefore provides a theoretical and methodological approach for addressing auditory user experiences.

Phenomenology is a fundamental science of knowledge. In its objective of describing the world beyond subjective prejudice and assumptions, phenomenology serves as an ideal starting point for inquiring into the phenomena of auditory experiences. Phenomenology, therefore, proposes an interesting way to include human experiences in the process of designing and evaluating auditory experiences.

In his last unfinished book, *The Crisis of European Sciences and Transcendental Phenomenology*, Edmund Husserl (1859-1938), who is considered the founder of phenomenology, complained about how European sciences have forgotten about the fundament for all our knowledge, the lifeworld[18]. According to Husserl, the scientific focus on the world does not include

[18]. The lifeworld is the everyday world in which we live, and reflections of the lifeworld were common among ancient Greek philosophers such as Socrates and Plato (Smith A. D., 2003)

the world in which we live, think, and act, and thus does not reflect on the biases this lived world produces. This problem is also widespread within modern acoustics, according to the Canadian composer Barry Truax[19] in his book *Acoustic Communication* from 2001:

> "Books on acoustics, following the general development of the discipline, have come to rely more and more heavily on visual representations of their subject matter […] One only has to go back to the writings of the 19th-century acousticians with their ingenious demonstrations of acoustic principles through sounding experiments, or their examples drawn from such real-world experiences as Tyndall's observation that 'the day was acoustically clear; at a distance of 10 miles the horn yielded a plain sound,' to understand how far the modern scientific approach has led us away from everyday perception […] The essentials of scientific knowledge seem not to have filtered down to the level of general public awareness, and too often decisions are left to 'experts' who speak only a technical language." (Truax, 2001, s. 3-4)

Husserl particularly problematised the psychophysical approach to experience:

> "When physics determine the physical given exclusively by such concepts as atoms, ions, energies, and so forth, and as, in any case, space-filling processes for which the only characterisations are mathematical expressions, it means them as something transcendent to the whole physical-thing content standing there 'in person'. As a consequence, it cannot mean the physical thing as something located in the natural space pertaining to the senses. In other words, the space of physics cannot be the space belonging to the world given 'in person' in perception" (Husserl, 1982, s. 84)

Phenomenology offers an explanation for why humans perceive and experience differently, without the rationalistic rejection of the existence of an external reality, and the explanatory nature of phenomenology provides an apparatus for describing experiential issues related to auditory user experiences.

[19] Barry Truax was involved in World Soundscape Project (WSP) founded Raymond Murray Schafer in 1960s at Simon Fraser University in California, and a part of the tradition of acoustic ecology initiated by the WSP (Truax, 2001, s. xxv).

Understanding the structures of experience is a first important step to theorising user experiences; without a robust notion of what constitutes experience, theoretical constructions related to user experiences will not be convincing. This chapter presents a description of experiential structures through a phenomenological lens, which in the following chapters will be utilised in the forming of a tool that facilitates evaluation and analysis within auditory interaction design. By applying a phenomenological perspective, the focus is on the user's way of experiencing.

The root of phenomenology

What is phenomenology? Merleau-Ponty asks in his preface to *The Phenomenology of Perception* (Merleau-Ponty, 2005). He stated that since Husserl's first writings on phenomenology, there have been various discussions of how to approach the phenomenological concept of essence and its relation to the lived life. Not only is phenomenology an inquiry into grasping the lived life, but it is also a matter of transcending the lived life in order to grasp the subject matter. Phenomenology is the study of experience as it is lived, as well as the study of how phenomena appear to consciousness through mental acts.

> "It is a transcendental philosophy which places in abeyance the assertions arising out of the natural attitude, the better to understand them; but it is also a philosophy for which the world is always 'ready there' before the reflection begins." (Merleau-Ponty, 2005, s. vii)

With the ambition of forming a *first* philosophy, a science of the beginning, the Husserlian transcendental phenomenology was born out of a criticism of the subject-object ontology of empiricism (Locke and Hume) and rationalism (Descarte and Leibniz), two contrasting philosophical schools of thought that were the zenith of philosophy in Husserl's time (Merleau-Ponty, 2005, s. xxii). Even though phenomenological views and logic have been practised for centuries[20], it was not until the early 20th century that it became a philosophy of its own right, and subsequently dominated the tradition of continental European philosophy (Smith, 2018). Phenomenology is considered to have been founded by Edmund Husserl (1859-1938) and has been

[20] Immanuel Kant (1724-1804) and Georg Wilhelm Friedrich Hegel (1770-1831) are examples of prominent philosophical thinkers who used the term phenomenology in their philosophical work before Husserl turned phenomenology into a philosophy of its own right (Crowell, 2009).

promoted by influential philosophical thinkers such as Martin Heidegger, Max Scheler, Alfred Schütz, Paul Ricoeur, Jean-Paul Satre and Maurice Merleau-Ponty (Zahavi, 2007).

Phenomenology rejects the idea of the existence of a real-world beyond our perceptual abilities and claims that what we perceive is the only real world. To understand a phenomenon is to focus on the phenomenon through our senses and subjective evaluation. Phenomenological inquiries are therefore on how we experience, sense and understand a phenomenon, and on factors influential for our different experiential perspectives.

According to phenomenological thinkers, knowledge-creation is neither purely an *a priori* or *a posteriori* process, but a synthesis of these, and the subject is an inseparable and integrated part of the objective world which it cannot escape. In phenomenology, even though consciousness is the centre of an *In-der-Welt-sein*[21], it is not the primary access to the world. The philosophical objective in phenomenology is to go beyond the concept of subject and object, to make an analytic reflection of experiences. The natural world is the source for every perception, and perceptions are the condition from which all acts, judgement, analyses and predictions come. We cannot make any reflections without being experienced with the elements we are reflecting upon:

> "All cognitions are sustained by a 'ground' of postulates and finally by our communication with the world as primary embodiment of rationality." (Merleau-Ponty, 2005, s. xxiii)

A phenomenological approach also rejects the concept of mental models as defined by classical cognitive scientists, which are static representations independent of our lived life. In phenomenology, internal representations are both influenced and formed by environmental and sociocultural factors, as well as mental states and prior experiences. Moreover, phenomenologists claim that we are not capable of representing external objects in our mind, only adumbrations of these objects that are continually changing depending on both our sensing, the properties of the external object and inner experiences.

Husserl initiated his phenomenological thinking at the beginning of the 20th century in his work, *Logical Investigations*. Back to the things themselves is a central aim of his

[21] *In-der-Welt-sein* is often translated into *Being-in-the*-world, and it is a term coined by Heidegger in an attempt to overcome the separation of subject and object. The concept indicates the subject's link to the objective world, which is explained through intentionality (Heidegger, 1996, s. 26-27).

phenomenological approach and refers to finding the essence of a phenomenon[22], through a process of isolating subjective attitudes. This quest of uncovering the primordial data of phenomena is achieved through a thorough understanding of how human consciousness and human experiences operate.

Phenomenology is predominantly regarded as a movement, or a way of thinking rather than a discipline of its own since the epistemological and ontological shaping of phenomenology is an on-going work and the processes of how to get to the *things themselves* are not agreed upon (Merleau-Ponty, 2005, s. xxiv) (Fällman, 2003, s. 15-16). It has been applied as an analytic foundation in many different scientific fields ranging from the American sociocultural orientations (Alfred Schutz, Harold Garfinkel, Peter Berger and Thomas Luckmann) to the European-based phenomenology found in Aesthetics (Mikel Dufrenne and Roman Ingarden), Existentialism (Jean-Paul Sartre, Martin Heidegger and Merleau-Ponty) and Semiotics (Charles Peirce). Their perspective on how to get back to the thing themselves is related but not homogeneous. For instance, for Husserl, consciousness is the starting point for inquiries into the essence of the phenomena, whereas Merleau-Ponty claims the body to be the starting point for phenomenological inquiries, and that bodily experiences come before conscious experiences. Heidegger initiated his phenomenological study on our functional relationship to the world, whereas Harold Garfinkel took the social order as the starting point for experiencing the world.

Phenomenology has also had direct relevance to computational design. In the book "What computers can't do" (Dreyfus, 1972) from the 1970s, the philosopher Hubert L. Dreyfus used a phenomenological ontology to give a general critique of the view of the brain as a simple information processing system that was found within Artificial intelligence (AI) research. According to Dreyfus, we need to have the correct theory of human cognition when designing computational devices. As mentioned in the previous chapter, Dag Svanæs (1999) and the HCI professor Daniel Fällman (2003) applied the phenomenological concept of embodiment to the field of HCI, and other researchers within HCI and Interaction Design who have applied a phenomenological attitude to their design research are Winograd & Flores (1986) and Paul Dourish (2004).

[22]In phenomenology, phenomena denote physical and psychological objects and events, other people, and oneself, as they are given to our consciousness.

.

The natural attitude and Lebenswelt

Husserl's research into consciousness began in his early work, found in *Logical Investigations* (Husserl, 2001). It appeared in full bloom in his later work *Ideas Pertaining to a Pure Phenomenological Philosophy* (Husserl, 1982) (Husserl, 1993), where he introduces the concepts of natural attitude and horizon.

The *natural attitude* is our everyday primary attitude in life and refers to our immediate and direct (intuitive) grasping of the actualities in the world (Husserl, 1982, s. 51-53). In this mode, we turn to things as they are given to us: We take the being of the world for granted, and philosophical reflections on being and doubts about reality are *bracket*:

> "The *natural attitude* of the mind is not concerned with the critique of knowledge. In such an attitude, our attention is turned – in acts of intuition and thought – *to things* given to us, and given as matter of course, even though they are given in different ways and in different modes of being according to the source and level of our knowledge of them […] It is to this world that judgement refer […] we infer from what is directly experienced in perception and memory to what is not experienced; we generalise; we apply knowledge to particular cases, or, in analytical thought, deduce new generalisations from general knowledge."
> (Husserl, The Idea of Phenomenology, 1999, s. 15)

Everything we experience in the natural attitude is real to us. Accordingly, we should not consider the experience of virtual reality as less real than experiencing a non-virtual world, the difference is not whether our experience is based on a digitalised or non-digitalized world, but in the experience itself.

The natural attitude is not just an attitude found among people going on doing their everyday life. According to Husserl, too many scientific fields practice this attitude without their awareness, by not being critical towards experiential subtleties when they make hypotheses or theorising. According to Husserl, we need to separate our preconceptions and prejudices (our natural attitude) from the phenomenon itself, in order to thoroughly understand what we are investigating (Husserl,

1982, s. 44). We cannot rely on theories and concepts without being aware of how the natural attitude influences our world view and the aspects we choose to attend to:

The following passage from the French writer, Antoine de Saint-Exupéry (1900-1944), perfectly frames the influence of the natural attitude in science in his famous children's fable *The Little Prince*:

> "This asteroid has been sighted only once by telescope, in 1909 by a Turkish astronomer, who had then made a formal demonstration of his discovery at an International Astronomical Congress. But no one had believed him on account of the way he was dressed […] Fortunately for the reputation of Asteroid B-612, a Turkish dictator ordered his people, on pain of death, to wear European clothes. The astronomer repeated his demonstration in 1920, wearing a very elegant suit. And this time everybody believed him." (Saint-Exupéry, 2000, s. 9-10)

Prejudice against the profile of people is not just an attitude found in fables, but is just as commonplace in the real non-fictional scientific world:

> "Being overlooked is an experience familiar to many in science. In a 2014 study of minority ethnic women in science, 100% of those surveyed reported encountering gender bias. Yet there no suggestion that such discrimination was deliberate. Rather, it is often the result of unconscious, also known as implicit, bias." (Chapman & Lalloo, 2017)

Closely connected to the natural attitude, we find the concept of the *Lebenswelt* (i.e., the lived world), which was a great inspiration for Merleau-Ponty. Lebenswelt is the foundation of our everyday life; it is our everyday language, social practices, bodily interaction with the world, and all sciences and philosophies are a product of this Lebenswelt.

Lebenswelt is a contrast to the world presented in natural science, in the sense that natural science operates in a world that we do not experience in our everyday life; we do not see the world from above (i.e., map view) in our everyday lives, we do not experience the world as molecules,

and we do not hear sounds as sinus waves or audiograms. Attributes of the Lebenswelt include our geographical, temporal, historical, bodily, linguistic, and sociocultural situatedness.

The natural attitude must not be confused with Lebenswelt. The natural attitude involves various levels of beliefs, prejudgments (e.g., philosophical, scientific and ideological preconceptions of the world) and anticipations based on a fusion of prior and present experiences of the present world, and the Lebenswelt is the present world. Thus, the natural attitude is the collection of inner contextual properties that affect our experiences, and the Lebenswelt is the external context affecting our experiences.

In Husserl's phenomenology, the natural attitude is considered the primary attitude - always present no matter what other attitudes are being applied:

> "Natural cognition begins with experience and remains *within* experience. In the theoretical attitude which we call the *natural <theoretical attitude>* the collective horizon of possible investigations is therefore designated with *one* word: It is the world." (Husserl, 1982, s. 5)

The concept of horizon introduced in chapter 2, is the set of possible cognitive and bodily engagements with the world, which, according to Husserl, is shaped by our applied attitude(s). The horizon of the natural attitude signifies the always stable background of taken-for-granted beliefs against which our experiences take place (Crowell, 2009, s. 20). As we see in the above quote, Husserl's addition of *theoretical* to the natural attitude suggests that the natural attitude is also reflective. We do make reflections in our natural attitude, but the Lebenswelt and our *being in the world* are not questioned. The ever-present and taken-for-granted characteristics of the natural attitude also serve as a foundation for our cognitive stability:

> "No doubt about or rejection of data belonging to the natural world alters in any respect the *general positing which characterises the natural* attitude. The world [the horizon of the natural attitude] is always there as an actuality, even if this or that is to be struck *out of it* and given such titles as 'illusion' and 'hallucination' and the like." (Husserl, 1982, s. 57)

Husserl often contrasted the natural attitude with the philosophical (phenomenological) attitude, that is, from which we turn inward to reflect on how the world appears before our consciousness, and from which the *being in the world* is questioned. This philosophical reflection is the foundation of this thesis - a reflection on what constitutes experience and how such an understanding can advance our inquiries into auditory user experiences in general.

The phenomenological methods

Husserl argues that we have to thematise and question the natural attitude in scientific inquiries. The *epoché*, or phenomenological reduction, is his proposed method for suspending (but not rejecting) our natural attitude, that is, suspending our subjective preconceptions of the world (Husserl, 1982, s. 54). By recognising and suspending our natural attitude, we will be able to recognise the things for themselves, that is, the essence of phenomena (Merleau-Ponty, 2005, s. xv).

Another reduction that is essential to phenomenology is the *eidetic reduction*. The eidetic reduction is about getting *back to the things themselves*, that is the essence of a phenomenon, the pure *eido*. The eidetic reduction is a philosophical reflection, applied after the phenomenological reduction:

> "The eidetic reduction is, on the other hand, the determination to bring the world to light as it is before any falling back on ourselves has occurred, it is the ambition to make reflection emulate the unreflective life of consciousness." (Merleau-Ponty, 2005, s. xvii)

We may differentiate between the natural attitude and the eidetic attitude. The natural attitude is a direct and immediate perception of phenomena that inhabit the world, while the eidetic attitude moves beyond this direct understanding of phenomena, by taking on a reflective posture that focuses on perceiving phenomena without prior judgement and anticipation, and aims at investigating a phenomenon through various perspectives to identify its invariant characteristics

A third reduction mentioned by Husserl is the transcendental reduction that relates to the experiences of the subject, the *transcendental ego*. It is not a return to things themselves, as with eidetic reduction, but a return to the experiential mind. The notion of the transcendental ego was introduced in Husserl's later work, where it became a key concept. The transcendental ego is the

fundament for our intentional acts, and experience is the phenomenon that glues together the transcendental ego to the external world. The transcendental ego is permanent and relates intentional acts to each other, and is therefore fundamental for all our knowledge in the world; a transcendental ego is required to perceive the world. Consequently, to understand the mental acts involved in specific experiences, a *transcendental reduction* has to be applied.

According to Merleau-Ponty, phenomenology can only be practised through the phenomenological method, which is descriptive, and therefore not a matter of analysing or explaining. This understanding of phenomenology is shared by Husserl, who in his early work, labelled phenomenology as *descriptive psychology* (Merleau-Ponty, 2005, s. xi).

Since this thesis focuses on how to understand the cognitive acts behind listening, the process can be expressed as a transcendental reduction of the phenomenon of listening. Thus, making phenomenological investigations into a specific auditory experience is a matter of investigating the auditory phenomenon through different listening perspectives to reveal its essence (i.e., eido), that is, its invariant characteristics. This thesis proposes an overview of the possible listening perspectives through which auditory phenomena can be experienced.

The approach is descriptive, and the ambition is to produce a model that illustrates sound perception through listening structures, which can be applied as a tool that gives designers an overview of the multiple ways in which a user can experience sound design and other auditory phenomena.

A phenomenological reduction (i.e., epoché) was applied in the early stages of the thesis in my framing of the problem area. Through a reduction of my natural attitude towards listening, the inquiries into describing auditory experiences initiated. Through literature review, experiential dimensions of listening were identified and placed into a framework, which subsequently was translated into a model aimed at designers and researchers alike.

I will argue that no one is capable of applying a pure phenomenological reduction, that is, no one is capable of completely bracketing the natural attitude since the very process of bracketing rests on our natural attitude to the world. To bracket our natural attitude will be to question every known aspect in our life; from our labelling and categorising of things, to our directness towards the world. Even our choice of investigating one phenomenon above another has to be questioned when applying a pure phenomenological reduction. Like Husserl, I find the natural attitude as a primary

attitude existing in all aspect of the lived life, an attitude that will never cease to be present. When we choose to reflect upon our natural attitude, we will only be able to reflect on parts of it, and our reflection will be based on the exact same natural attitude. For instance, when investigating a auditory phenomenon, a bracketing of the whole natural attitude will mean to question every possible preconception of not only the particular auditory phenomenon but also on all other auditory phenomena that surrounds this sound, as well as the whole concept of sound itself, which would be a difficult – if not impossible task. It is far more likely that a researcher practising phenomenology only turns their phenomenological reduction towards parts of a phenomenon, such as the structure of sounds or the musicality of sounds. A phenomenological reduction is therefore not a matter of bracketing the natural attitude in general, but only the natural attitude towards parts of the phenomenon.

I will also argue that people apply both a natural and phenomenological attitude in their everyday lives. The daily lives of people are not only experienced through a natural attitude. All humans question their natural attitude on various levels in their daily lives, particularly when experiencing something new, a breakdown, or something unexpected; from wondering why one's bike is suddenly making a strange noise to questioning prior conceptions of the soundscape when suffering from age-related hearing loss tries on hearing aids for the first time. In these occasions, people cannot rely on their previous experiences and has no other options than to put on a phenomenological attitude to understand and tackle these unfamiliar situations. Thus, the term analytic attitude seems to be more appropriate than the phenomenological, eidetic or philosophical attitude to describe this everyday questioning of the Lebenswelt.

Since all scientific investigations and design process rest on a (direct or indirectly) specific philosophical belief of how human beings experience and interact with the world (Husserl, 1982, s. 17-18), I consider investigations into the human experiential structures fundamental for making any inquiries into auditory use experiences. Knowing its ontological foundation is vital for moving auditory user experience evaluations beyond the current engineering and psychoacoustical world-view. Thus, this thesis is an attempt to provide a comprehensive eidetic understanding of sound perception upon which both practical and empirical, as well as theoretical, investigations can be built.

Phenomenology and the account of experience

Experience is a rich concept, and there have been many attempts to define it. When consulting dictionaries, we do see two overall denotations of the word experience; one that relates to the gain of knowledge, and one that relates to a personal encountering with entities and events in the world as they occur over time.

Whereas English uses one word for both knowledge gain and perceptions of the world, Germanic languages such as German and Danish, use different words. In German, these to significations are translated into *erfahrung* (knowledge gained, life experience) and *erlebnis* (lived experience), and in Danish, they are translated respectively into *erfaring* and *oplevelse*. With these translations in mind, we do see that the term user experience, which is translated to *benutzer-erlebnis* in German and *bruger-oplevelser* in Danish, refers to the lived experience of the user.

Experience from the first-person point of view is the starting point of phenomenology, and is the epistemological foundation of phenomenological research, as lived experience is the source of all human knowledge.

Eidetic hearing

Since Husserl was interested in constructing a systematic framework for understanding experience, he was preoccupied with the question of consciousness. Inspired by Brentano, he defined consciousness as an inner awareness that includes everything that belongs to someone's experience. This definition implies that all the mental acts (e.g., perceptions, imaginations, conceptual thinking, assumptions, doubts, emotions, wishes, and acts of will) are a part of consciousness (Siewert, 2009, s. 81-82).

However, according to Husserl, we are only capable of experiencing external objects partially; that is, we only have adumbrations[23] that are one-sided experiences of things:

> "A spatial being can 'appear' only in a certain 'orientation,' which necessarily predelineates a system of possible new orientations each of which, in turn, corresponds to a certain 'mode of appearance' which we can express, say, as givenness from such an such a 'side' and so forth." (Husserl, 1982, s. 91)

[23] An English translation of the word *Abschattungen*.

Through these adumbrations, we form an idealised concept of what we perceive in our minds, that is, our eidetic seeing. Being comprised of a collection of one-sided adumbrations, an eidetic seeing (or hearing in our case) is not equal to the observed phenomenon itself, and its idealised form is not static but undergoes constant changes depending on further experiences and context. Applying this understanding to auditory phenomena, we can assume that only parts or specific dimensions of a sound (such as the cause of the sound) are perceived, and these parts form our auditory experience. Figure 4 illustrates the relationship between perceptual phenomena and experience.

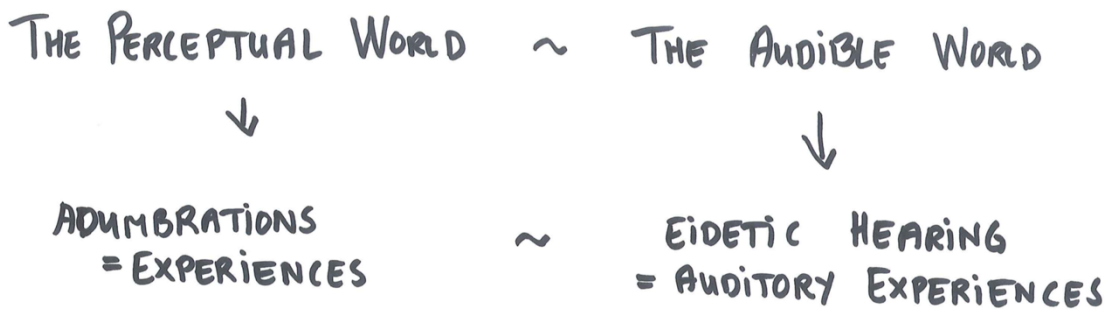

Figure 4: Our auditory experiences as eidetic hearing.

This understanding of auditory experiences implies that for every time we hear a specific sound, new aspects show up and change our eidetic experience of that sound, and from a phenomenological outlook, strengthen our knowledge of this specific sound phenomenon:

> "[…] to their [the spatial being] essence belongs the ideal possibility of their changing into determinately ordered continuous multiplicities of perception which can always be continued, thus which are never completed. It is then inherent in the essential structure of those multiplicities that they bring about a unity of a *harmoniously presentive* consciousness and, more particularly, of the *one* perceptual physical thing appearing ever more perfectly, from ever new sides, with an ever-greater wealth of determinations" (Husserl, 1982, s. 91)

Husserl additionally states in the above quote that it will never be possible to reveal the complete essence of things since the number of possible perspectives from which a phenomenon can be perceived is infinite.

Pierre Schaeffer[24], a highly influential musicologist, composer and music theorist, recognised this adumbrational aspect of auditory experiences, as he called *variation in listening*. As a consequence, he proposed repeated listening as a method for getting a more detailed description of sounds:

> "In addition, as these repetitions [repeated listening] take place under physically identical conditions, we become aware of the variations in our listening and can better understand what is generally called its 'subjectivity'. This is by no means, as we may perhaps be inclined to think, an imperfection, for example some 'blurriness' scrambling the physical signal, but different perspectives or ways of hearing that are accurate every time, and every time reveal a new aspect of the object, which engages or deliberate our unconscious attention." (Schaeffer, 2017, s. 64)

According to Schaeffer, the process of repeatedly listening to a sound will reveal previously unheard dimensions of the sound that can be related to either the sound itself or the event or object signified by the sound (i.e., the sound-producing object or event), and that have the potential of changing our eidetic depiction of the sound or the connotations conveyed by the sound. Thus, through the repeated listening method, Schaeffer, applies a phenomenological attitude in his investigation of auditory phenomena.

Empathic directedness

According to Husserl, we are only capable of having original experiences of ourselves, objects and events in the world - not of other people, since we can only experience others' states of mind or thoughts indirectly through their bodily expressions:

[24] Schaeffer was a pioneer in describing listening from a phenomenological point of view, where listening is not just regarded as a straightforward physiological response to auditory stimuli but is intentionally constituted through listening modes. Schaeffer's quest was to investigate sound through phenomenological reductions (Kane, L'Objet Sonore Maintenant: Pierre Schaeffer, sound objects and the phenomenological reduction, 2007).

> "[…] we 'view mental processes of others' on the basis of the perception of their outward manifestation in the organism. This empathic viewing is, more particular, an intuiting, a presentive act, although no longer an act that is presentive of something originary." (Husserl, 1982, s. 6)

This quote suggests an empathic directedness to the world, where we direct ourselves to others to understand their emotional state and thoughts, which relates very well to Wright, Wallace and McCarthy's (2008) concept of *empathic design thinking* mentioned in chapter 3 (p 43). This empathic directedness can also be pointed towards objects or events; for instance, emotional qualities are manifested in the design when a text message is perceived as antagonistic, a specific colour is considered as happy, or a song is interpreted as sad. We are not necessarily affected by these qualities, even though we recognise them in a design. Empathic listening should there not be confused with emotional effects. For instance, we might sense a sadness in a song even though it does not make us feel sad, and we might consider a voice to be angry even though it does not make us feel angry.

Experiences are valued

Another relevant point in Husserl's experiential descriptions is that phenomena are not just experienced, but also valued:

> "Moreover, this world is there for me not only as a world of mere things, but also with the same immediacy as a *world of objects with values, a world of goods, a practical world*. I simply find the physical things in front of me furnished not only with merely material determinations but also with value-characteristics, as beautiful and ugly, pleasant and unpleasant, agreeable or disagreeable, and the like […] Naturally this applies not only in the case of the 'merely physical things,' but also in the case of humans and brute animals belonging to my surroundings" (Husserl, 1982, s. 53)

Thus, objects are given to us on two levels; through our directness and our valuation:

> "If we are directed to a thing in the act of valuing, then our direction to the thing itself is a heeding of it, a seizing upon it; but we are 'directed' – not only to the *objectivating of the thing* but also to the *valuing of the thing* […]" (Husserl, 1982, s. 76)

Knowledge related to this valuing process is central to user experience designers since these value-characteristics are the experienced qualities of the interaction and the design.

Implications for evaluating auditory interaction design

- Evaluations should be based on lived experiences, that is, on first-person descriptions.
- Since we only perceive the world in adumbrations, evaluations cannot give a full objective picture of the evaluated phenomenon but are subjective experiences of a phenomenon that may vary a lot from person to person. Thus, to get into the essence of an investigated phenomena, repeated exposure is necessary.
- Experiencing is not just a matter of directing oneself towards the world, but it is also a valuing process. Value-characteristics can be compared to the quality assessment of designs.
- We have an inner picture of what we perceive that is continuously changing because of the constant changes in the lived world and because we never stop experiencing. Thus, results from an evaluation cannot be validated through replicating an experiment or evaluation session. Moreover, people's values and opinions are very much likely to change over time.
- The more we listen to sounds; the more details will appear. Thus, people undergoing an evaluation session might have to repeat their listening to pinpoint their listening experiences better.
- We can be empathically directed towards other people as well as things, that is, we can listen empathically without being emotionally affected.

The body – the organ of hearing

In phenomenology, the body is the medium for perception, and Husserl describes the body as the *organ of perception* (Husserl, 1982, s. 61). Through this body of perception, we sense through the eyes and ears, our smelling organs and tactility.

Husserl distinguishes between the body as a *corpse* (Körper) and the body as a *lived body* (Leib). The body as a corpse is the body viewed from a third-person perspective, whereas the body as a lived body is the body viewed from a first-person perspective (Husserl, 1993, s. 152ff). Viewing the body as a corpse is a consideration of the body as an object among other objects: it is heated or cooled; it can be damaged or enhanced, and it can be healthy or impaired. The lived body is spatial and orientating, where external objects appear either *nearer or farther, above or below, left or right* from the body. With the lived body, we find ourselves at the centre of all external occurrences, the *zero point* of all orientations (Husserl, 1993, s. 167). Husserl's concept of the lived body inspired Merleau-Ponty, and he took the concept as his phenomenological starting point. Merleau-Ponty saw the body as a medium to apprehend the world and therefore the basis for all experiences, which is also backed by McCarthy & Wright's pragmatic view on the sensual experiential thread that correlates with Husserl and Merleau-Ponty's bodily experiencing:

> "Sensual is a critical medium through which humans can interact with the external world." (McCarthy & Wright, 2004, s. 26)

Merleau-Ponty and Husserl, however, differed in certain details such as whether it is the body or the consciousness that has the leading role in creating experiences: Husserl ascribed consciousness as the driving factor in our experiential processes, whereas Merleau-Ponty assigned the lived body as the fundament for all our experiences. Despite their differences, they both shared the idea of experiences being created through a synthesis of bodily and cognitive processes rather than a Cartesian separation of mind and body; they both regarded experience as being connected to the external world through our bodily sensing of qualities given by external objects or events, and then internalised through our consciousness. Thus, if the properties of an external object or event change, so will our experience. Merleau-Ponty labelled the body as *the medium for perception*, where Husserl referred to the body as the *organ of perception* (Husserl, 1982, s. 61). Whether the driving factor behind our experiential directness is our consciousness or bodily senses will not be discussed in this thesis, but Husserl and Merleau-Ponty's agreement about the body is the interface between the external world and our consciousness, is maintained in this thesis.

From a third-person point of view, the organs of perception (to use the terminology of Husserl) that is associated with the auditory environment can be referred to as the organs of hearing, and involve the physiological ear (detects acoustic signals) and nervous system (detects the vibration of sounds). Our neurosensory system consists of *proprioceptors*, *exteroceptors* and *interoceptors*. Proprioceptors are sensory neurons that provide information related to our muscular system; i.e. the position and movements of our limbs and joints. Exteroceptors detects stimuli from the external world and are located on the skin, eyes, oral cavity, ears, and nose. *Interoceptors* detects stimuli from inside the body, such as blood pressure, hunger, movement of the heart. Thus, experiences expressed through these organs of hearing concern the physical impact of sounds.

Positioning the body as the mediator of all perception places substantial weight on our sensorimotor abilities (i.e., the physiological abilities) since our organs of perception are the connecting point to the external world. In figure 5, an illustration of the connection between perceptible phenomena, organs of perception and experience are explained in terms of acoustic signals, organs of hearing and auditory experiences:

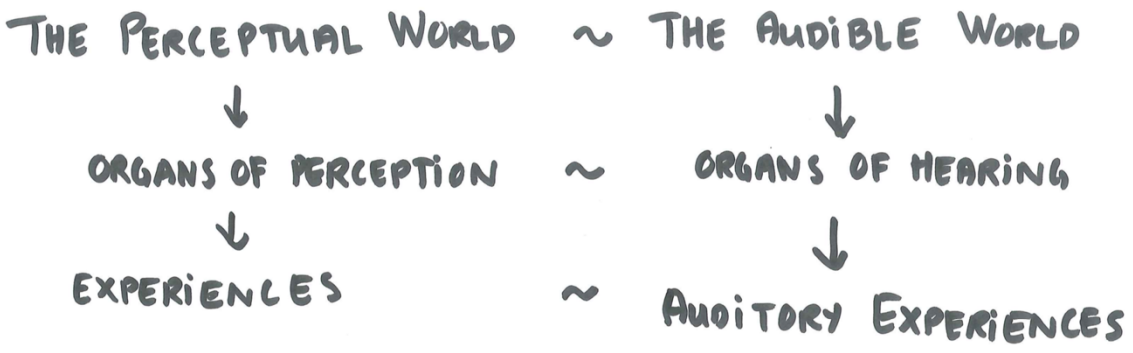

Figure 5: From acoustic signals to auditory experiences.

The arrows in figure 5 are not suggesting that our (auditory) experiences do not influence our bodily actions and that our embodiment is not affecting the world. The arrows only serve the purpose of emphasising that the focus of this thesis is on factors influential to our experiences. Moreover, it is important to stress that auditory experiences are not only affected by acoustic phenomena, but by our whole sensorial perceptual apparatus. However, to narrow down the

research field, the effect of non-acoustic phenomena on auditory experiences is left out in the present thesis.

Seth S. Horowitz, PhD and assistant research professor in the departments of neuroscience and psychology at Brown University, described in his book "The Universal Sense" the hearing sense as the most basic universal sense among all living creatures: You will find blind animals, but no deaf animals exist (Horowitz, 2012, s. 3). For humans and other animals, detectable vibrations propagating through the ears, skin and bone are information to be either noticed or ignored. These vibrations are used as warning systems and for orientation, detection and communication. Although the hearing is a vital component in all living organism, Horowitz argues that we are not very knowledgeable about how we experience the auditory world:

> "If it [our hearing sense] is so crucial a sense, why do we humans so often ignore it at a conscious level, unless we are trying desperately to block out noise of the subway or checking out music?" (Horowitz, 2012, s. 3)

Objects and the lived body

Husserl distinguishes between *active* and *passive* perceiving concerning our perceptual experiences. In passive perceiving, we are acting instinctively (i.e., pre-reflectively); we attend to things in a habitual manner. Thus, these passive intuitions are exposed through our habits and instinctive behaviours. They are determined acts we register, but no longer pay attention to - like when we grasp a glass of water, turn our heads for better listening, move one foot in front of the other while walking, or shift gears in a car while driving. Opposed to passive perceptions, we find active perceptions. Active perceptions are attentive bodily acts that involve the conscious ego, like when we listen to a sound to identify the characteristics of the source, or when we attentively watch the road while driving a car. Active perceiving is an actively and reflectively engagement of our body in the world. However, the active perception always rests upon passive perceptions; that is, our habits and routines tacitly govern our perceptual directness and experiences.

Merleau-Ponty regarded the concept of passive perceptions (i.e., pre-reflective bodily acts) as one of the explanation problems traditional philosophies have, as they tend to view all acts as a

product of intellectual synthesis. As Merleau-Ponty states, we do not analyse our movements before dancing, walking or running (Merleau-Ponty, 2005, s. 164-165). According to Merleau-Ponty, bodily habits are acts that are directed by prior stored bodily and cognitive experiences. The sensorimotor perceptual system learns from the lived body and is therefore capable of executing physical acts without cognitive reflection, but purely based on this accumulated knowledge. Note, that this claim does not suggest that habitual bodily acts are carried out non-consciously, but instead suggest that habitual acts are carried out pre-reflectively. The difference between a non-conscious and a pre-reflective bodily act can be demonstrated in our example of walking: While walking, we are not just putting one foot unconsciously in front of the other, but are subconsciously aware of the terrain in which we are walking. Sometimes we are walking up a hill; sometimes down a hill; sometimes we have to walk over obstacles; sometimes we have to slow down or speed up – all the various terrains we experience while walking requires the involvement of a conscious mind. Thus, habitual acts can be defined as acts based on a cognitive bodily "knowledge". This *bodily knowledge* is also a philosophical foundation of the pragmatic design thinking, where meeting the intuitive and spontaneous acts of everyday life, the *knowing-in-action*, is considered the main element in design knowledge (Schön, 1983) (Fallman, 2003, s. 227).

Merleau-Ponty extends the concept of habitual acting to include external objects as parts of our bodily knowledge. According to Merleau-Ponty, when we become used to operating physical objects in the lived world, they cease to be objects but become a part of our lived body[25]:

> "The blind man's stick has ceased to be an object for him, and is no longer perceived for itself; its point has become an area of sensitivity, extending the scope and active radius of touch, and providing a parallel to sight […] To get used to a hat, a car or a stick is to be transplanted into them, or conversely, to incorporate them into the bulk of our own body." (Merleau-Ponty, 2005, s. 165-166)

In this thesis, I apply this understanding of the possibility of physical objects to become a part of the lived body. All objects through which our sensorimotor acts are mediated has the potential to become a part of the lived body. Experiencing an object as a part of the lived body is just a matter

[25] Inquiries into this extension of the body is the focal point in Martin Heidegger's phenomenological approach.

of being so accustomed to operating the object, so that the focus is no longer on the object, but on the experiences mediated through the object. Thus, the aim for tool-based devices such as hearing aids and headphones is their ability to become a part of the lived body.

Implications for evaluating auditory user experiences

- Our body can either be understood as organs-as-a-corpse or organs-as-the-lived-body. In the former, the body is viewed objectively, and in the latter, the body is a mediator of experiences. Objective viewing is often the case if our body is malfunctioning or when we analyse the body. Organs of hearing refer to the body as a corpse.
- Organs as lived bodies are spatially situated and regarded as the *zero point*s of all our orientations. This situatedness and orientation of our lived body influence the perspectives in which we experience (i.e., adumbrations).
- Devices that mediate our hearing are considered a part of our hearing organs, and can equally be seen as either organs-as-an-item or organs-as-the-lived-body. Devices considered as organs-as-items are directly attended to as a result of a breakdown in their functionality, a lack of familiarity, or because the device is analysed. Devices as lived bodies are not attended to directly but are considered a part of our bodily functioning. The way users experience a device exposes the quality of the design. Is the design designed for reflections or invisibility? Moreover, how well are these designerly intentions met?
- Our bodily interaction with the world can both be reflective and pre-reflective.

Perception as the sensorial experience

Husserl makes a distinction between experience and perception. The Husserlian concept of perception refers to cognized sensorimotor experiences and is considered the most original part of experiencing. Hence, perceptual experiences are our direct experience of vision, touch, smell, movements, as well as sounds. This direct communication with the external world gives perceptual experience its primal role.

In the phenomenological view, the world is given in our perceptual experience; that is, perception is our actual encounter with the world. Perceptions are sensed data mediated through a

subjective consciousness, and therefore not a one-to-one grasping of the external world in an empiricist sense. Husserl denotes perception as the *original experience* since all other experiences are rooted here:

> "We have originary experience of concrete physical things in 'external perception,' but no longer in memory or in forward-regarding expectation.'" (Husserl, 1982, s. 6)

Objects may be conceived as being immediately given, but they are in fact always mediated and private, since sensed data is always mediated through the consciousness before it turns into a perceptual experience:

> "In perception, the perceived object is supposed to be immediately given. There stands the thing before my perceiving eyes. I see it; I grasp it. But the perception is nothing more than an experience that belongs to me, the perceiving subject." (Husserl, 1999, s. 17)

Alongside Husserl, Merleau-Ponty also defines experiences as mediated through a body that connects us with the world. The body belongs to the world and is our primary source of experiences. However, instead of perception, Merleau-Ponty talks about sense-experience and sensorial impressions. Sensorial impressions are the detections of physical occurrences such as light and sound waves, whereas sense-experiences are the subjective appreciations of the sensorial impressions:

> "Rather, to see is to have colours or lights, to hear is to have sounds, to sense (sentir) is to have qualities." (Merleau-Ponty, 2005, s. 5)

Thus, to have sounds refers to the sensorial impressions, that is our physiological and neurological capability of detecting sounds through the organs of hearing (i.e., outer and inner ear, skin, neurological auditory processes, as well as the audio-mediating devices), whereas *to have qualities* refers to auditory sense experience, which is private and subjective. The word *perception* is defined in various ways depending on scientific fields and scholar traditions, but in the current thesis, the term perception will only refer to Husserl's definition.

Following this understanding, sound perception through our organ of hearing and auditory perception can be translated into an *auditory embodied directness* in which the subject connects to the external object. Thus, auditory experiences can be translated into auditory *perceptual* experiences, as illustrated in figure 6:

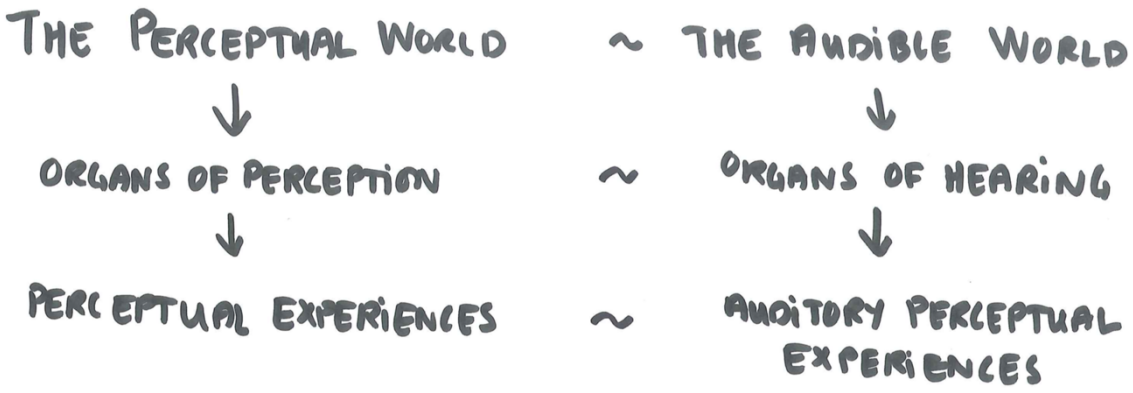

Figure 6: From acoustic signals to auditory perceptual experiences

Pierre Schaeffer argues that measurements and descriptions of acoustic properties are insufficient when investigating the human perceptual experiences of sounds. He opposed the approach often found in acoustics where musical experiences are explained based on acoustic laws and theories. As an example, he mentions the Meyer-Eppler's theory claiming that every musical sound can be reproduced synthetically without losing any of its qualities and characteristics, based on a time-frequency diagram and without including any considerations on human perceptual experiences:

> "It seems, however, that once the physical makeup of sounds and the workings of that more or less perfect device, the ear, are understood, there is nothing else really important for him [the physicist] to learn. He does not even claim to give an account of our auditory sensations (as for the concept of perception, this is totally absent from his thinking) but explains them in terms of their material *causes*, having taken into account the transformations they undergo on the way […] Doubtless not every specialist will go with him all the way. But doubtless none of them would reject his attempt at explaining itself, considered as the height of the scientific mode of discovery […] Indeed, we can see that

they [physics] merely refer to ‘musical sensations,’ as if sensations were the prime factor of musical consciousness. Now, sensation is not instantly there in our consciousness; it comes, in general, only from a selection process on the part of perception” (Schaeffer, 2017, s. 99-100)

Figure 7 illustrates Schaeffer’s interpretation of the physicist's approach in which physical measurements and values are applied to explain musical experiential values.

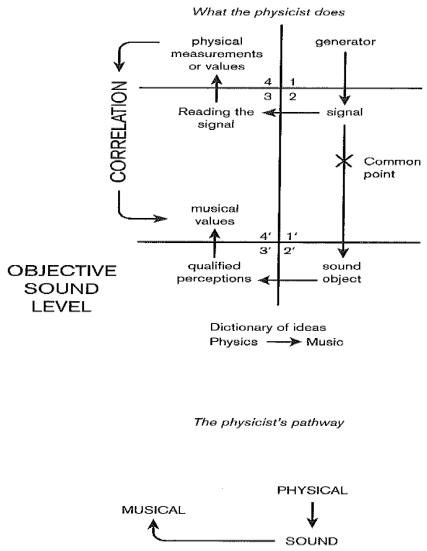

Figure 7: Schaeffer’s scientific approach (Schaeffer, 2017, s. 106) .

For Schaeffer, explaining auditory perceptual experiences based on sound waves is like explaining visual perceptual experiences of a painting based on the light rays. Suppose you are wearing hearing aids, then think about what you really experience: the experiences conditioned by the hearing aids are not pure frequencies; instead you hear the car going by in the street, the birds in the sky and people talking. Thus, we are not experiencing acoustic signals, but auditory events mixed together on a canvas of background sounds.

It is important to notice that Schaeffer's critique is not pointed at acoustical epistemologies, but at applying an acoustic understanding to make postulations about human auditory experiences.

Believing that the auditory experiences have to be investigated through other practices and methodologies than what is offered by the scientific field of acoustics, Schaeffer turned to the Husserl's phenomenology for inspiration.

Implications for evaluating auditory interaction design

- Perceptual experiences are mediated through our consciousness and are, therefore, always private and subjective.
- Perceptual experiences are first experiences, and should always be attended by a designer.
- We cannot use acoustical perspectives to postulate about auditory perceptual experiences. User experiential evaluations have to include first-person experiences.

The auditory perceptual field – the soundscape

Husserl describes our perceiving capacity as *intuition*s and the collection of perceivable actualities[26] (i.e., possible perceptions) as the *perceptual field*. These possible perceptions depend on our inner and outer horizon that is shaped by our bodily movements, direction, the spatiotemporal field, prior experiences and perceptual capabilities (Drummond, 2007, s. 97). In this case of auditory experiences, our perceptual field consists of an infinite range of acoustic actualities -perceivable as well as non-perceivable. The auditory perceptual field is, therefore, not the sum of all acoustic signals in an environment. The auditory perceptual field is a subset of the set of acoustic signals in an environment since the auditory perceptual field only consists of perceived and potentially perceivable acoustic signals - not those that are inaudible to the human ear.

According to Horowitz, we are not able to avoid acoustic actualities since a state of complete silence is not possible. Every day, we are met by millions of sounds like the rumble of the traffic, hum of ventilator systems, people talking, sirens and birds in the sky:

[26] Actualities are concrete objects, actions or events that are evidentially present (Drummond, 2007, s. 33).

> "There is no such thing as silence. We are constantly immersed in and affected by sound and vibration. In truly quiet places you can even hear the sound of air molecules vibrating inside your ear canals or the noise of fluid in your ears themselves. Even black holes produce vibrations. And the reasons the constant thrumming does not drive us all insane are the same reasons we get distracted by radio jingles and can't read when the TV is on: We are good at choosing what we hear." (Horowitz, 2012, s. 2,4)

Consequently, we are constantly surrounded by acoustic actualities: some are perceived, others are not; some are attended to, and others are not, and some are clearly understood while others are only vaguely understood - if understood at all.

As we examine the auditory perceptual field, we turn unnoticed and indeterminate sounds into noticed and determinate ones. However, no matter for how long we listen, the set of unnoticed and indeterminate sounds will never be exhausted – there will always be new aspects, new perspectives and new previously unheard sounds that are turned into heard sounds. This constant change in our auditory awareness is not only due to our adumbration-oriented perceiving but also because of the fluctuating and temporal nature of sounds that continuously change the set of acoustic actualities in the perceptual field. Sounds are memorised and determined, and co-exist with the infinite horizon of indeterminate sounds in the perceptual field:

> "Along with the ones now perceived, other actual objects [e.g., sound] are there for me as determinate, as more or less well known, without being themselves perceived or, indeed, present in any other mode of intuition […] What is now perceived and what is more or less clearly co-present and determinate (or at least somewhat determinate), are penetrated and surrounded by an *obscurely intended to horizon of indeterminate actualities* […]" (Husserl, 1982, s. 51)

These potentially perceivable acoustic actualities each offers a new perspective on the auditory perceptual field when perceived, and as explained earlier in this chapter, they have the potential to completely change the eidetic hearing, that is, the auditory experience.

Our perceiving capabilities refer to our hearing organs, and the state of our hearing organs affects our perceptual field and thus the auditory experience. For instance, changing from listening to a song on the radio without headphones to listen to the same song through noise-cancelling headphones brings up different experiences. In the first case, the auditory perceptual field is much more varied and complex than what is experienced in the latter case.

Pierre Schaeffer's critique of applying a physicist's approach to investigate musical experiences does not only concern the subjective nature of perceptions but also their unawareness of the context in which the listening takes place (Schaeffer, 2017, s. 105-108). Experiments and evaluations conducted in lab settings only capture the experience of the played acoustic signals, and not the real-life experiences of the played signals as they are mingled with the surrounding environmental sounds:

> "This is why most response curves of the ear, set up for elementary stimuli, do not apply to complex signals or simultaneous sounds in the context of strictly music listening, which has nothing in common with the quasi-surgical condition of a well-conducted sensory experiment." (Schaeffer, 2017, s. 101)

Ignoring these experiential aspects makes result from evaluations done in controlled lab settings insufficient in explaining real-world experiences.

In their seminal book "Sonic Effects", Jean-François Augoyard[27] and Henry Torgue[28] criticised Schaeffer for the same reasons as Schaeffer criticised the scientific approach to musical experiences. They find his bottom-up approach to sound (i.e., researching single sounds phenomenologically) not applicable in analysing the complexity of everyday sound environments, since the auditory perceptual field is not just a sum of its parts (i.e., not just the sum of different sounds). By only focusing on single sounds, Schaeffer's approach is not useful to understand the overall complex composition of everyday sound environments (Kreutzfeldt, 2009, s. 172). Since everyday auditory environments are the starting point in all lived experiences, reflections on the everyday soundscape have to be included in evaluations of auditory user experiences.

[27] Founder of CRESSON
[28] Director of CRESSON

The term *soundscape* was coined by Schafer, a Canadian composer and music pedagogue, in the 1970s. Schafer's soundscape refers to the auditory scenery accompanying geographical locations. An auditory scenery includes all kinds of sounds made from nature, humans and objects, and they can both real and abstract. Soundscapes are described and analysed in their holistic form. Schafer's definition of the soundscape is to be found in the back of his "The Tuning of the World":

> "The sonic environment. Technically, any portion of the sonic environment regarded as a field of study. The term may refer to actual environments, or to abstract constructions such as musical compositions and tape montages, particularly when considered as an environment" (Schaefer, 1994, s. 274-275).

Husserl's definition of the auditory perceptual field is comparable to R. Murray Schafer's definition of the soundscape. The difference is that the auditory perceptual field consists of both perceived and not-yet-perceived acoustic actualities, whereas the soundscape only refers to the perceived sounds. Schafer approached his research through graphical notations and classification tools based on tape recordings of historical and modern soundscapes. In his ecological perspective, he regarded the soundscape as a musical composition that can be measured by its aesthetical values such as the level of noise and clarity. Schafer aimed to teach people to listen, and he saw the noise of urban areas as pollution to the ear. Noisy sceneries were labelled low-fi environments, and soundscapes, where individual sounds are clearly heard and distinguishable from each other, are labelled high-fi environments. Transmission quality descriptions inspire Schafer's use of the terms high-fi and low-fi. Hi-fi environments describe environments in which single sounds are heard clearly. Low-fi environments, on the other hand, describe poor transmission qualities of sounds.

In 1995, the philosopher and musicologist, Jean-François Augoyard and music composer Henry Torgue offered an alternative to Schafer's methodology of describing the acoustic environment through physically measuring acoustic signals in their book "Sonic Experiences" (Augoyard & Torgue, 2005). In this book, they described research result from CRESSON's investigations into sonic effects identified through everyday experiences of listeners. CRESSON investigated the relationship between acoustics, sociology and architecture in urban settings as a movement against the Cartesian view and visual approach that dominated architecture and city planning at that time.

They aimed to get away from the static and objectified spatial acoustic view, and over to a more flexible and changeable definition of the acoustic space. Their work mainly consists of first-person reports from interviews and tape recordings from residential areas, upon which fundamental sonic effects were identified. As a part of CRESSON, Augoyard and Torgue criticise the empiricist approach found in architecture and urban planning, where research is based on objective measurements with no interest in first-person perspectives, but instead applying morpho-typological classifications to describe sonic environments. Augoyard and Torgue's critique of architectural sound inquiry approaches is very similar to Pierre Schaeffer's critique of using acoustic descriptions to explain auditory perceptual experiences (see page 85-87). Architectural sound descriptions predominantly presented acoustical data of the sound environment, such as signal transmission losses in visual forms, and subsequently correlated this information with behaviours of those living in the environment. Augoyard and Torgue argued that by only observing sounds objectively we would only be able to describe the relation between acoustic signals and human behaviour, not the underlying experience that triggers these behaviours (Augoyard & Torgue, 2005, s. 5). That Augoyard and Torgue's approach is phenomenological, is not only noticeable in their research methods but also apparent in the sonic effects they have identified. These effects do include not only psychoacoustic terms such as echo, delays and reverberation but also non-psychoacoustic terms related to bodily and mentally everyday lived experiences (Kreutzfeldt, 2009).

Augoyard and Torgue saw their approach as filling the gap between Schaeffer's bottom-up approach to sounds and Schafer's top-down ecological approach. Through their concept of the *sonic effect*, Augoyard & Torgue expanded the toolbox of descriptive tools for describing auditory environments through their inclusion of experiential descriptions of everyday non-musical sounds (2005, s. 6-8). Their ambition was to build a bridge between the urban designer and the inhabitants of the investigated location through their terminology, by merging the aesthetics of sound production to the aesthetic of sound reception (Kreutzfeldt, 2009, s. 165).

Their descriptive tool was first applied in social science to investigate human perception and behaviour. Through surveys, they collected information from inhabitants on the felt quality of the sound environment. Through direct observations, they placed the information from the inhabitants into context and looked into whether these effects could be directly observed, measured or related to specific spatial contexts. Jacob Kreutzfeldt, PhD in Modern Culture and Communication and

Head of Struer Tracks[29], questioned the effectiveness of Torgue and Augoyard's analytic tool, since it does not distinguish between individual experiential effects such as *anticipation* and collective experiential effects such as *masking* and *clip*. However, from a phenomenological perspective, we might argue that all experiences are individual, but some experiences are more easily shared among people than others.

The acoustic qualities of the acoustic signal and the structure of the soundscape are not the only factors influencing our auditory experience. As pointed out earlier, organs of hearing, spatial orientation and movement our body influence our auditory perceptual experiences, just as well as prior experiences (Merleau-Ponty, 2005). Turning to auditory interfaces, we see that the influence of bodily orientation and movement only applies to geographically situated interfaces and hear-through mobile technologies, whereas listening through headphones excludes these bodily influences: we can move around in different acoustic environments and turn our body in different directions without affecting the acoustic quality or the spatial location of the sound. Thus, virtual soundscapes might not be directly influenced by our bodily behaviour. However, in the last decade(s), the auditory technology industry has exploited 3D audio design and sensing technologies to bring in bodily movements and spatial orientations to the proposed auditory interactions. The Danish start-up company the AWE, who develops location-based audio-augmented reality[30] is an example of a company that merges virtual auditory interfaces with bodily movements (see chapter 7 for a more thorough presentation).

According to Augoyard, perception and practice are closely tied together in lived experiences (Augoyard, 2007) (Kreutzfeldt, 2009, s. 154). Augoyard focuses on territories as an auditory perceptual phenomenon, making the perceiving subject a starting point for his methodological approach. *Sound marking* (sound marks) and *sound effect* are two central terms in Augoyard's work. Through the concept of sound marking, Augoyard criticises the humanistic approach to territorial thinking, which is often seen from a traditional ethological perspective that operates with dominance, possession, geographical markings (property, sovereignty and boundaries) and the urge to sustain territories through specific behaviour. He sees territory behaviours as being more nuanced then what is presented in the traditional ethology, and argues that territories might as well be drawn

[29] Struer Tracks is an urban sound art festival held in Denmark in June 2017.
[30] https://theawe.dk/1807-2/

by differences in the acoustic milieus, a theme that was the pivotal topic in Jacob Kreutzfeldt's PhD dissertation (Kreutzfeldt, 2009), and which he named acoustic territories.

Acoustic imperialism

With his phenomenological perspective, Augoyard described sounds as shaping a room where the ear is the shaping instrument, and not as the acousticians, who describe sounds as being shaped by the room (Kreutzfeldt, 2009, s. 161). Thus, through the experiential lens, sounds can define and shape spatial properties, whereas through acoustic lens sounds are restricted by the spatial properties that affect the physical propagational behaviour of acoustic signals.

Considering sound as shaping the external space rather than the other way around, was also shared by Schafer and can be observed in his terminology. For instance, in his definition of *acoustic imperialism*, he describes some sounds as dominating others and by that shaping our experience of the external space. However, he only ties this concept to modern sound-producing technologies that he predominantly found imperialistic. For Schafer, all sounds that are dominating the soundscape are imperialistic. This definition has to be viewed in the light of his aversion to the modern urban soundscape that he saw as suffocating the subtler sounds of nature. It is my belief, though, that dominant sounds are not necessarily imperialistic. According to the encyclopaedia Britannica, imperialism is "*...state policy, practice, or advocacy of extending power and dominion, especially by direct territorial acquisition or by gaining political and economic control of other areas.*", which implies territorial acquisition through power. Thus, I find the intention behind the sound produced as the determining factor for whether a sound should be considered imperialistic or not: When a department turns up the music to dominate the music from other departments, it can be seen as imperialistic, whereas the sound of a drill is not imperialistic since there is no intention behind to dominate the acoustic space.

Implication for evaluating auditory interaction design

- The auditory perceptual field consists of an infinite number of perceived and not yet perceived auditory actualities.
- The more we listen to the acoustical perceptual field, the more sounds will be exposed, and the more comprehensive our soundscape experiences will become.

- Investigations into auditory experiences have to be conducted in real-life settings.
- Through a phenomenological lens, sounds shape the external environment, as well as the environment, shapes the sounds. Investigations into auditory user experiences should, therefore, be based on first-person experiential descriptions and not on acoustic descriptions.
- The soundscape can be divided into acoustic territories, where changes in the acoustic characteristics of a soundscape mark the territories.
- Soundscapes are mostly described through psychoacoustic descriptions (e.g., Hi-fi vs low-fi, sounds dominating through their loudness, the transmission quality of foreground sounds, and the level of noise). However, non-psychoacoustic descriptions such as acoustic territories and imperialistic sounds are also applied.
- Some sounds dominate others, but they can only be regarded as imperialistic if the intention behind the sound is to dominate the soundscape. Acoustic territories can be described and evaluated through sound marks (i.e., the influential sounds in the territory).

Listening focus

In the field of auditory perceived actualities that surround us in our everyday life, i.e., the soundscape, our attention is never fixed, but wanders around and moves sounds in and out of focus:

"I can let my attention wander away from the writing-table which was just now seen and noticed […] Objects I directly 'know of' as being there and here in the surroundings of which there is also consciousness – a 'knowing of them' which involves no conceptual thinking and which changes into a clear intuition only with the advertence of attention, and even then only partially and for the most part very imperfect." (Husserl, 1982, s. 51-52)

Thus, we are not only intuiting sounds in the soundscape attentively but also, less attentively, its close perceivable "surroundings":

> “anything perceived has an experiential background […] They were appearing and yet were not seized upon and picked out, not positing singly for themselves. Every perception of a

> physical thing has, in this manner, a halo of background-intuitions […] and that is also a '*mental process of consciousness*' or more briefly, 'consciousness,' and, more particularly, '*of*' all that which in fact lies in the objective 'background' seen along with it." (Husserl, 1982, s. 70)

In this quote, Husserl's use of the word objective does not refer to the factual physical world, but the background of objects as they appear in consciousness.

When being familiar with the perceptual field, we are more likely to passively perceiving, whereas being unfamiliar in the perceptual field often results in a higher attention level, since the level of indeterminates actualities that needs to be seized upon its much higher. Moving around in strange places makes us more aware of what we see, sleeping in unfamiliar surroundings makes us more aware of the sounds, and trying out new never-tried-before auditory interactions, as is often the case in the evaluation of explorative designs, makes us much more aware of what we hear. This knowledge not only argues for evaluations being conducted in the use situations to approximate the actual attentional level, but also an awareness that the unfamiliarity with the evaluated product might influence the results.

Listening focus is often treated in a dichotomous manner with a sharp division between background and foreground listening, expressed in terms such as *inattentive/attentive* listening, *active/passive* listening, and *focused/unfocused* listening. A widely used assumption within musicology is that background listening is of more inferior quality and has, therefore, not received much attention in music research (Lilliestam, 2013).

Another common assumption in the foreground-background dichotomy is that our attention is distributed in a static manner, which conflicts with Husserl's description of the constant shift of attention in our everyday living. This assumption implies that when, for instance, listening to the radio in the background while driving a car, the driving of the car will always be having our primary attention and the listening to the radio will always be secondary. However, is this always the case? Are there not times our listening tunes in to the radio and places our attention to driving in the background? As, when a piece of relevant news is reported or when our favourite song is played. Based on empirical findings, Lars Lilliestam, professor of Musicology at the University of Gothenburg, agrees with Husserl and demonstrates that it is not possible to draw a sharp line in our

attentional focus (2013, s. 5). For instance, where is the primary focus when a person cooks and listening to music at the same time? As Lilliestam asks rhetorically; "Do I listen to music while I cook, or do I cook while I listen to music?" and "When I dance, do I listen 'passively' or 'actively'?" According to Lilliestam, it is possible to listen while doing other things, and still concentrating on the music/sound, but he also argues that it is nearly impossible to stay concentrated all the time when listening to a song. We are all the time interrupted by our thoughts all the time (Lilliestam, 2013, s. 13).

In the mid-1980s, Helmut Rösing a German musicologist explained listening as predominantly being practised between the two extreme states attentive and inattentive listening, where he argues that these two states are rarely practised (Rösing, 1984, s. 134). In between these two poles, we find different degrees of passive and active acoustic perceptions. According to Rösing, our everyday listening is predominantly inattentive; that is, our natural attitude in listening is found to be predominately based on passive perceptions. In the EPSI-model listening focus as described as being a specific level of attentiveness, where inattentive describes the least attentive listening focus and immersion describes the highest degree of attentiveness.

Implication for evaluating auditory interaction design

- We perceive sounds with different levels of attention. Some sounds are only registered in the periphery (e.g., hearing music in the background in a supermarket), whereas other sounds are attended to with great focus (e.g., when analysing a car engine through its sounds).
- Our listening attention can be placed anywhere on a scale from inattentive to attentive listening, based on our inner and outer horizon.
- It is difficult to draw a clear line between attentive and inattentive listening, since the attention-level in listening is not static, but is shaped in the dialogue between the listener and the environment.
- Full concentration on sounds is not commonplace. Designers should, therefore, not by default, assume a focused listening from their users.
- The listening focus can be either non-intentional or intentional, that is, based on either passive or active perceptions. Most of everyday listening is based on inattentive.

The temporalities of experiences

Present experiences are not just a successive collection of direct perceptions but are constituted by, direct perceptions, prior experiences and anticipations. This rationale is based on Husserl's concept of inner time (Siewert, 2009, s. 84) (Crowell, 2009, s. 23). When experiencing, present perceptions are synthesised with the *just-perceived* (retentions) and *anticipations of the closely followed subsequent perceptions* (protentions). According to Husserl, our mental acts occur in different inner temporalities: No matter what we experience, we are retentively conscious, in a way that makes it possible for us to make sense of current perceptions and anticipate experiences. When we listen to a song, no matter if it is a known or unknown song, we anticipate how it will unfold, based on what we hear and what we have just heard; When listening to the sound of a car on the road, we anticipate whether the sound will intensify or decline (i.e. the direction the car is moving), based on how the sound has unfolded so far; When listening to conversations, we anticipate what will be said next, based on what is said and what has just been said. Thus, the retentional consciousness is a structure of prior perceptions registered consciously and subconsciously. Experience is, therefore, a synthesis of retentions, direct perceptions and protentions. Husserl describes the relationship between protensions and direct perception as *empty*, because the protentions, being anticipated perceptions, has not yet been experienced, so thus not yet been confirmed. For instance, when looking at a house, we anticipate that there is a backside, but so far we have no evidence that this backside actually exists. If our expectation is met, the relationship is no longer empty, but *fulfilled*, because what we anticipated is now registered with our senses and can be confirmed or unconfirmed.

For instance, sometimes we "see" a hidden backside of a box when looking at a box, we "hear" what is said in a conversation before it is actually said, and we "feel" the nail scratching on a blackboard when someone mentions it. If we do see the "hidden" backside of the box, when walking around the box, if we do hear the words we anticipated to hear, and if we do get the same feeling as we anticipated when scratching our nail on a blackboard, our experience is, according to Husserl, fulfilled. Instead, if we go around the box without seeing a backside, the word said did not match what we anticipated, and the feeling of scratching our nail on the blackboard felt differently than anticipated, our experiences are not fulfilled, and we may start reflecting why this is the case.

Experiences that are not fulfilled result in a correction of our eidetic seeing or our stable natural attitude's horizon might blame it on a faulty perceptual experience.

Anticipated perceptions and experiences are not rooted in the external world, but in our mind, because our anticipated experiences do not exist in the factual external world.

However, retentions differ from memories in the sense that memories are not based on the living present, but are prior experiences that are unconnected to the actualities of the present world.

Implications for evaluating auditory interaction design

- Our experiences are a synthesis of retention, direct perception and protentions. Design is a matter of fulfilment – we need to understand the expectations of the users to fulfil their aims.
- A design might want to disrupt the sense of fulfilment in order to make the users reflect on the design.

Intentionality

Whether we talk about transcendental, hermeneutic, existential, or some other version of phenomenology, they do, however, have a common point of departure: the primary position of the concept of *intentionality.* Intentionality means to point, aim or direct towards some target goal or end. Intentionality is a theory of the consciousness as operating on two levels: 1) a consciousness that is experiencing (i.e., consciousness as mental acts) and 2) a consciousness that is experiencing something (i.e., a consciousness that is directed to an object).

The concept of intentionality played a central role in Husserl's transcendental phenomenology[31] (Smith, 2018). Inspired by the descriptive psychology of the German philosopher, psychologist and priest, Franz Brentano (1838–1917), Husserl brought the term *intentionality* into the centre of discussion in contemporary philosophy of the mind. In his attempt to define mental phenomena, Brentano borrowed the term intentionality from the Scholastics of the Middle Ages to contemporary philosophy in his influential work "Psychology from an Empirical Standpoint"[32] (Brentano, 1973)

[31] Also labelled *Pure Phenomenology*
[32] Original title is *Psychologie vom Empirischen Standpunkt* was published in 1874 by *Duncker and Humblot* in Leipzig. The second edition was published in 1924 by *Felix Meiner* in Leipzig.

published in 1924. Brentano saw intentionality as one of the six characteristics that differentiate mental phenomena from physical phenomena:

> "Nevertheless, psychologist in earlier times have already pointed out that there are a special affinity and analogy which exists among all mental phenomena, and which physical phenomena do not share […] Every mental phenomenon is characterised by what the Scholastics of the Middle Ages called the intentional (or mental) inexistence of an object […], in judgement something is affirmed or denied, in love loved, in hate hated, in desire desired and so on. This intentional in-existence is characteristic exclusively of mental phenomena. No physical phenomenon exhibits anything like it. We could, therefore, define mental phenomena by saying that they are those phenomena which contain an object intentionally within themselves." (Brentano, 1973, s. 88-89)

This *intention in-existence* of an object is what inspired Husserl's intentionality concept. Brenton's *mental phenomenon* was translated into *intentional experience* or *mental act* by Husserl, where *intentional* refers to the mental act of *aiming at*, or *referring to*.

For Brentano, consciousness was characterised by its always being concerned with something; every mental phenomenon such as ideas (i.e., conceptual thinking), perceptual experiences (e.g., hearing a sound, feeling warm, seeing an object), expectations, inferences, emotions, and fantasizing always involve being conscious of something. We cannot apply a mental act without being directed towards something, whether it is an object, subject, fantasy or event. Even highly physical sensation such as pain when being burned or cut, are linked to our conscious awareness of where the pain is located - that is our spatial awareness of the body part that hurts (e.g., our foot hurts) (Brentano, 1973, s. 78-83). Brentano tied experiential qualities to our mental acts rather than the physical phenomenon itself:

> "Even in cases where I hear a harmonious sound, the pleasure which I feel is not actually pleasure in the sound but pleasure in the hearing" (Brentano, 1973, s. 90)

Through this understanding, Brentano rejected the traditional view of experiential qualities being directly linked to physical phenomena, that dominated the field of psychology at his time. Instead, he saw experiential qualities as instances mediated through consciousness, and by that, made a distinction between experiential qualities and qualities of objects in the physical world. This rationale also explains why sensational experiences differ from person to person, even when they are experiencing the same physical phenomenon (e.g., like the different experience of loudness between people hearing the same sound).

Brentano's view on consciousness as being referential in an active and on-going process was an inspiration for Husserl:

> "Being genuinely alive is always having one's attention turned to this and that, turned to something as an end or a means, as relevant or irrelevant, interesting or indifferent, private or public, to something that is in daily demand or to something that is startlingly new." (Husserl, 1965, s. 166)

As we see, Husserl focuses on consciousness and how it is directed toward the world through the concept of intentionality. Encouraged by Brentano, Husserl did the thesis that our conscious mind is always directed towards an object, and this intentional object can be an object in the literal sense (i.e., physical object in the world) or something more abstract such as an idea, feeling or event. When we perceive, we are not just perceiving, but we always perceive *something*.

> “Universally it belongs to the essence of every actional cogito to be consciousness *of* something […] All mental processes having these essential properties in common are also called *intentive mental processes* (acts in the broadest sense of *Logische Untersuchung*); in so far as they are conscious of something, they are said to be *intentively referred* to this something.” (Husserl, 1982, s. 73)

Husserl’s definition of intentionality is manifested in two ways: The *noema* that refers to the intentional object as it appears in our mind, and the character of the intentional mental act is the *noesis*. In other words, the noema is the *object content* of intentionality, and the noesis is the *acting*

content of intentionality (Husserl, 1982, s. 211ff). Since noema is how a phenomenon appears in our mind, an evaluation session is, in a phenomenological sense, an evaluation of the noema rather than of the perceived object's factuality. In our case of auditory experiences, the noesis refers to the act of listening and noema refers to how the intended to sound appears before the mind. A noema is an abstract object that cannot exist without noetic acts, and noeses only exist in its reference to the noematic content. Thus, intentionality consists of three mutually depended parts: the noetic operation, the noematic content, and the intended to object (see figure 8).

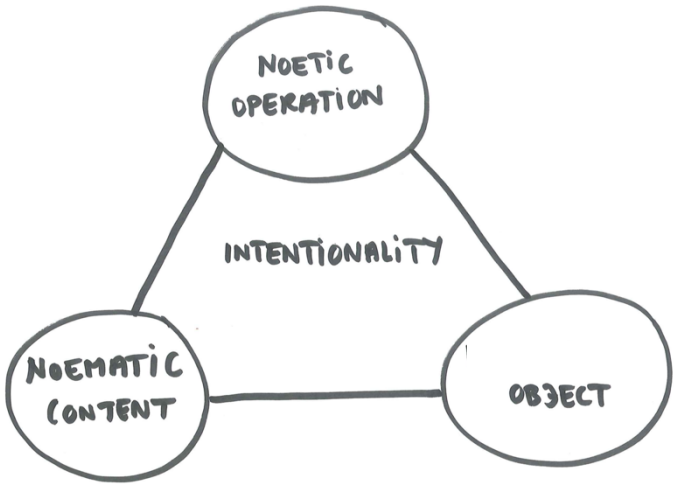

Figure 8: The components of Intentionality.

The noema is not a representational copy of the perceived object, but a synthesis of biased and adumbrational perceptions of the object, that is, our eidetic seeing of the object. This description of the noema implies that an object can relate to many noemata, but a noema cannot be related to different objects.

Husserl made a distinction between two ways of directing towards physical objects; we can direct ourselves through direct perception or *signitive-symbolic objectivation*. Perceptual directness refers to noemata directly related to the perceived object, whereas signitive-symbolic objectivations refer to noemata based on mental abstractions of the perceived object.

> "Between *perception*, on the one hand, and *depictive-symbolic* or *signitive-symbolic objectivation*, on the other hand, there is an unbridgeable essential difference. In the latter kinds of objectivation, we intuit something in consciousness as depicting or signitively

indicating something else, having the one in our field of intuition we are directed, not to it, bit to the other, what is depicted or designated, through the medium of a founded apprehending." (Husserl, 1982, s. 93)

Applying Husserl's distinction between *perception* and *signitive-symbolic objectivation* to auditory experiences, two overall types of noemata are suggested: One that relates to the perceived sound itself, and one that relates to a symbolic-signitive abstraction of the perceived sound. As an example, when experiencing an ambulance siren, we can be directed to the immediate rhythmic structure of the sound itself, or we can focus on an abstraction of the sound such as someone is badly hurt and now are on their way to the hospital (see figure 9).

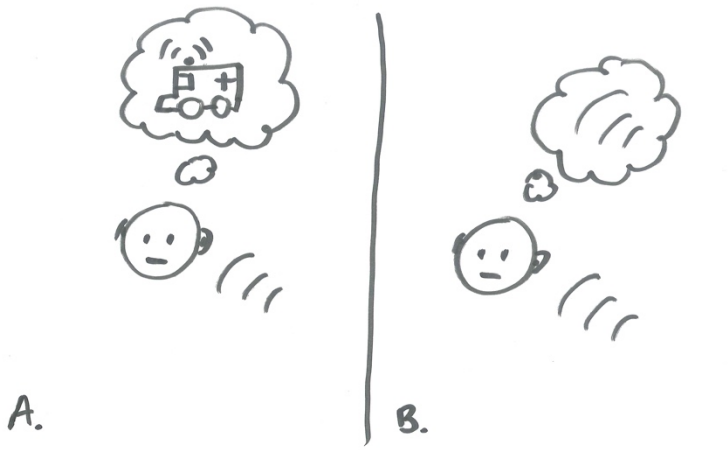

Figure 9: (A) Subjective-Symbolic objectivation, (B) direct perception.

These two experiential focuses should not be confused with each other since they produce two very different types of noemata: one that focuses on qualities related to the concrete sound itself, and one that focuses on an abstract inference of the concrete sound.

Thus, one crucial aspect of describing auditory user experience will, therefore, be to separate these two different ways of experiencing sounds.

Intentionality and the sound object

In 1966, Schaeffer introduced a new vocabulary for how to discuss sounds in his "Traité des objets musicaux: essai interdisciplines" [33] (Schaeffer, 2017), a composition that has been substantial and indispensable to many previous and current researchers inquiring into sound, music and listening. It was in this seminal work of his that he formulated a phenomenological inquiry into sounds through the concept of the *l'objet sonore*, translated into *the sound object*. This phenomenological perspective applied to sound in musical research parted with the acoustic view on sounds that dominated his era. Schaeffer's concept of the sound object is parallel with Husserl's description of noema, that is, the intentional object. The sound object is not a representational copy of the intended to sound (i.e., the heard acoustic signals), but a mental phenomenon derived from how the listener *apprehends* the perceived sound (Schaeffer, 2017, s. 205-212). Hence, a sound object only exists if there is a sound to perceive and a subject to cognise the acoustic signals:

> "The object is 'the pole of identity immanent in particular personal experiences, and yet transcendental through the identity that goes beyond these particular experiences' […] Those particular personal experiences are the many visual, auditory, tactile impressions that follow each other in a never-ending flux […] In what way is the object *immanent* in these? Because it constitutes an *intentional unit*, involving *acts of synthesis*. These many experiences are directed toward the structure of my consciousness except by perpetually recognising it as 'consciousness of something'." (Schaeffer, 2017, s. 207)

From this incessant flux of sensorial impressions, the sound object comes into being through the intentional acts of the listener.

As with the noema, an intended to sound can produce many intentional sound objects, but one sound object cannot refer to many different perceived sound objects. As with the noema, the sound object is the product of the perceived acoustic signals and the noetic act of listening. (Augoyard & Torgue, 2005, s. 6)

The sound object refers to the sound object itself, and not to a signitive-symbolic objectivation of the sound object. The sound object is therefore independent of any causal or implied abstractions.

[33] *Traité des Objets Musicaux*, has been rewritten four times, and is the product of fifteen years of research into listening, *musique concréte*[33] and sound (Kane, 2014, s. 17).

The sound object only exists within our perceptual consciousness but can be materialised through our surrounding environment as well as through devices such as a tape recorder, computer and music player. When making changes to a sound on an auditory interface, we are not changing the sound object as well; instead, we are creating new sound objects. This definition shows a strict relationship between the perceived external sound and the sound object: Every change to a sound produces new sound objects, even when the changes are minimal. A change in the acoustic signal, the physical position of the listener or the mental state of the listener changes the sound object, and thus one sound might produce many different sound objects (see figure 10). However, different acoustic signals might produce very similar[34] sound object. According to Schaeffer, it has been possible to change the acoustic signal of a sound without creating a significantly different sound object: In one of his experiments, he changed the temporal structure of an acoustic signal (i.e., by slowing down or speeding up the sound) without creating a noteworthy different sound object (Schaeffer, Treatise on Musical Objects, 2017, s. 67) (Augoyards & Torgue, 2005, s. 6). A change in the intensity of an acoustic signal (through amplifying) can also be assumed to have a similar "non-influential" effect on the sound object. This acoustic signal and sound object coupling are illustrated in figure 10.

[34] It is my claim that it is not possible to produce the exact the same sound object in a listener mind due to the fluctuating nature of our conscious mind and the sound itself. We can produce similar sound objects, but not the exact same.

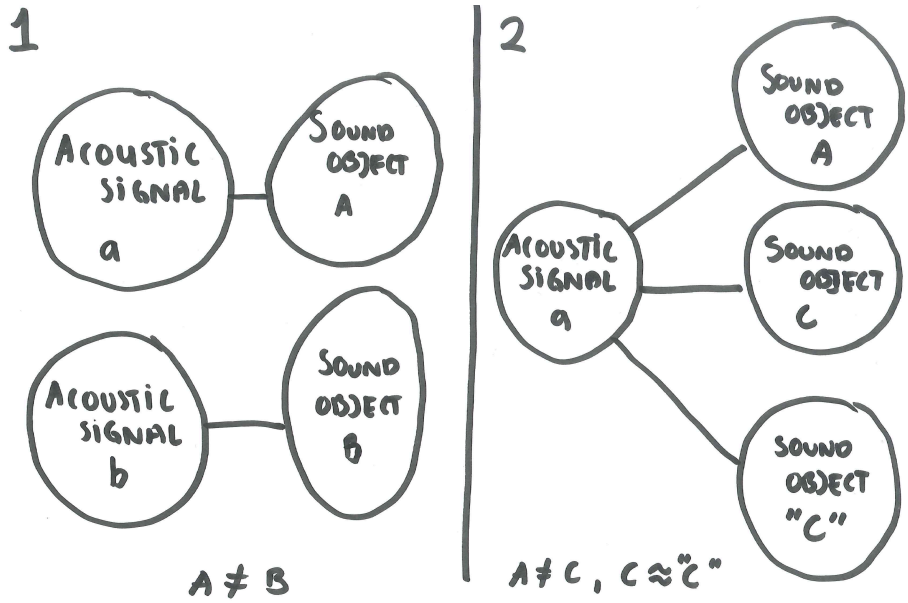

Figure 10: The relationship between acoustic signals and sound objects. 1) Illustrates that two different acoustic signals (a and b) produces two different sound objects and 2) illustrates that the same acoustic signal (a) may not only produce two different sound objects (A and C), but also similar sound objects (C and "C")

Living in the time of the invention of the tape recorder, Schaeffer added another term to his auditory vocabulary, *acousmatic*[35]. Acousmatic sounds are opposed to directly perceived sounds. In direct sounds, the cause of the sound is visible, whereas the cause in acousmatic sounds is invisible to the eye:

> "Acousmatic, adjective: is said of a noise that one hears without seeing what causes it. This term […] marks the perceptive reality of sound as such, as distinguished from the modes of its production and transmission" (Schaeffer, Acousmatics, 2007, s. 77).

[35] "Etymological, the term acousmatic is derived from a group of Pythagorean disciples known as akousmatikou (listeners or auditors), who, as legend has it, heard the philosopher lecture from behind a curtain. According to Chion, Pythagoras used the curtain to draw attention away from his physical appearance and toward the meaning of his discourse. The central role of the Pythagorean curtain in Schafferian tradition blocks the causal identification of acousmatic experience with modern audio technology in order to make a more striking claim" (Kane, 2014, s. 4-5).

According to the French composer and music theorist Michel Chion, acousmatic sounds are a common auditory phenomenon in the modern society, found in the ubiquitous presence of modern audio used in reproduction, transmission and storage technologies floating from computers, public loudspeakers and radios.

Sound objects are not necessarily a product of direct perceptions, but can also occur as a product of mental processes such as imaginations and memories.

Intentionality and listening focus

We might intend towards more than one noema, but often we find ourselves focusing on just one thing, whereas concurrently perceptions often are merely background intuitions. Our perceptual focus keeps on shifting in a horizon of potential perceivable objects, where objects on the fringe of our awareness transform into the centre of our awareness and vice versa: One minute we might focus on the melodic structure of a song and the next on the lyrics. (Schiermer, 2013, s. 17). As mentioned earlier in this chapter in the "Listening focus" section, not all perceptual acts are intentional processes. In fact, the majority of our perceptual acts are non-intentional. They operate in the background but are still playing a significant role in our overall experience (Husserl, 1982). We are seeing, hearing, feeling, smelling, without being directly conscious about it, but our experiences are highly based on these *hyletic*[36] data of background sensations:

> "One easily sees, that is, that *not every really inherent moment* in the concrete unity of an intentive mental process itself has the *fundamental characteristic, intentionality*, thus the property of being 'consciousness of something'. That concerns, for example, all *data of sensations* which play a so great role in perceptual intuitions of physical things […] The very same thing obtains in the case of other really inherent Data, for example, the so-called *sensuous feelings*" (Husserl, 1982, s. 73)

[36] Husserl's term for sensory data (sensorial impressions).

Husserl makes a distinction between two types of intentionality (Merleau-Ponty, 2005, s. xx): the *intentionality of acts*, which is a mental-oriented intentionality where we reflectively judge or take up a position, and the *operative intentionality*, which is equivalent to the earlier mentioned *passive perception*[37] and Donald Schön's concept of *knowing-in-action* (see page 75). Merleau-Ponty considered the operative intentionality as the primordial intentionality of the lived body:

> "[the operative intention] being apparent in our desires, our evaluations and in the landscape we see, more clearly than in objective knowledge, and furnished the text which our knowledge tries to translate into precise language" (Merleau-Ponty, 2005, s. xx)

As with passive perception, the operative intentionality is a bodily pre-reflective intentionality, mediated through our bodily habits, such as the automatic movement of our feet when walking, or when our eyes automatically turn towards light when being in a dark place, or when we pre-reflectively catches the sound of a familiar voice among unfamiliar voices. Operative intentionality also involves a noetic-noematic activity: Our bodily touching is touching something, our bodily seeing is seeing something, and our bodily listening is listening to something.

As Husserl, Merleau-Ponty considered the body as being a part of our experience of the world, and not just an independent entity. This understanding is also shared by McCarthy and Wright's (2004) pragmatic view on felt experience (see chapter 3). They both regard operative intentionality as a process on a subconscious level, and not as a nonconscious activity. Intentional acts on an operative level do cognise the intended-to object through fast involuntary, and thus subconscious, mental acts. On this subconscious level, the perceived object is given to the consciousness directly, but anonymously.

In his phenomenological investigations, Merleau-Ponty gave the body a central position. In contrast, Husserl saw our body is *a priori* governed by our mental intentionality, a difference that will not be brought into a discussion, as mentioned earlier in this chapter. The important point is that both Husserl and Merleau-Ponty view the body as the connection to the world; a connection made through our sensorimotor system (Husserl, 1993, s. 158) (Merleau-Ponty, 2005, s. xx). Thus, from a phenomenological perspective, the sensorimotor system is the foundation of all our

[37] (see the "The Body – the organ of hearing" section in this thesis) and Rösing's incidental listening (see page xxx).

experiences, which Merleau-Ponty implies between the lines in the following reference to René Descartes' concept of Cognito:

> "I am thinking of the Cartesian cogito, wanting to finish this work, feeling the coolness of the paper under my hand, and perceiving the trees of the boulevard through the window." (Merleau-Ponty, 2005, s. 429)

Merleau-Ponty also emphasises that all our senses blend and mutually affect each other. Information from one sense might alter the perception from the other senses, and our sensorial focus is continually changing between the different senses; sometimes we are more focused on our visual world, other times on the auditory world, and sometimes equally on both. According to Merleau-Ponty, this operative intentionality is what completes phenomenology as a *phenomenology of origins*.

The active perception, on the other hand, belongs to the intentionality of acts, that is a reflective directness pointing towards an object in the physical world.

Turning to our case of auditory experience this distinction correlates with the traditional distinction between hearing and listening found in a variety of scientific fields, where listening often implies cognition directness and hearing implies an automatic pre-reflective bodily directness:

> "[…] whereas hearing can be regarded as a somewhat passive ability that seems to work with or without conscious effort, listening implies an active role involving differing levels of attention […]" (Truax, 2001, s. 18)

As mentioned in the section "The body – the organ of hearing" in this thesis, bodily acts are not only done in a pre-reflective and operative intentional mode but can also be carried out in reflective manners. Thus, bodily acts can both be operative intentional acts and intentionality of acts. I will refer to bodily acts as an embodied intentional mode that defines belongingness to both the operative intentionality and intentionality of acts.

In this present thesis, hearing is regarded as bodily directness, although not as a passive, receptive process, but as an active embodied process that can be directed on an incidental or selectively basis, to use Rösing's terms.

Intentional modes

I will now move on to Husserl's concept of *actionality-modes*. Through this concept, Husserl introduces a way of thinking of experiential subjectivity. Our apprehension towards perceivable actualities is constantly changing, which leads to changes to the intentional content (i.e., the noema). Thus, experiences can conflict even though they are constructed on the same hyletic data; For instance, when we listen to a song, we may perceive the song as a collection of musical structures or through its lyrics. Actionality-modes can be considered as the root of our subjective experiences, as these different modes evoke different apprehensions of the same perceived object, without changing the core presence of this pre-given object:

> "It is in their actionality-modes that attentional formations have, in a pre-eminent manner the *characteristic of subjectiveness*, and this characteristic is consequently acquired by all the functioning which become modalized by these modes or which, according to their specific sort, presuppose them" (Husserl, 1982, s. 225)

In our case of auditory user experiences, these actionality-modes is considered as different modes of attending to a sound, or in brief, as different *listening modes*. Moreover, Wright, Wallace and McCarthy (2008) describe that different modes of experiencing are depended on both external and internal contexts of the experiencing subject (see page 46-47).

Thus, to understand auditory experiences, we will have to understand not just the various modes of directing to sounds, but also the personal background and situatedness in which this directedness' takes place. Moreover, since, noesis and noema are ontologically bonded and co-occurring, they cannot be apprehended without the other. Thus, the framework I will propose is not only an illustration of the noetic- noematic structure but also involves context on both an external and internal level.

Attitudes

According to Husserl, how our intentionality is directed depends on the attitude in which we meet the world. For instance, in the natural attitude we intent to the world differently than in, for example, an arithmetical attitude, since our horizon is changing with the change of attitude:

> "not every cogito[38] In which I live has as its cogitatum physical things, human beings, objects or affair-complexes of some kind or other that belong to my surrounding world. I busy myself, lets us say with pure numbers and their laws: Nothing like that is present in the surrounding world, this world of 'real actuality'. The world of numbers is likewise there for me presciely as the Object-field of arithmetical busiedness; during such busiedness single numbers of numerical formations will be at the focus of my regard, surrounded by a partly determinate, partly indeterminate arithmetical horizon […] *The arithmetical world is there for me only if, and as long as, I am in the arithmetical attitude* […] I appropriate to myself the arithmetical world and other similar 'worlds' by effecting the suitable attitude" (Husserl, 1982, s. 54)

Husserl argues for our use of different attitudes in our experiencing the world. When in an arithmetical mode, our intentionality tunes into arithmetical actualities and abstractions: We no longer see a house, but the geometrical shapes of the house and our view of the world is based on arithmetical axioms and laws. Thus, our attitude is a factor that drives our subjective focus. However, the natural attitude is our automatically applied attitude, so no matter what other attitudes we apply, the natural attitude will always co-exist:

> "In this case, the natural world *remains* '*on hand:*' afterwards, as well as before, I am in the natural attitude, *undisturbed* in it *by the new attitudes*. If my cogito is moving only in the worlds pertaining to these new attitudes, the natural world remains outside consideration; it is a background for my act-consciousness. The two worlds simultaneously present are *not connected*" (Husserl, 1982, s. 55)

In a footnote, Husserl specifies his claim that the natural world is disconnected to the non-natural attitudes, where the former relates to the external time-spatiality, whereas the other attitudes are

[38] Cogito is taken from "Cogito, ergo sum" a phrase coined by René Descartes, who was an inspiration for Husserl.

related to an abstract non-physical world. As mentioned earlier, I regard the natural attitude as being a practical attitude that is ever-present in our lived life. We can reflect upon it and thus turn it into another attitude. This attitude could be arithmetical, analytical or philosophical as with the phenomenological reduction. However, the natural attitude will always be present since our reflections on the natural attitude initiate from this very same attitude.

Husserl's concept of attitude can be related to interaction design as the underlying approach to the interaction that can be either natural/practical (e.g., when we interact in a tool-like way) or analytic/reflective (e.g., when we through the interaction question or reflect upon our behaviour). These interaction approaches might be predefined before an actual interaction takes place (e.g., approaching a photo-editing program for functional reasons) or take form during the interaction (e.g., like when you do not know how to operate an application and needs to reflect upon how to go on with your task).

Implication for evaluating auditory interaction design

- Experiences consist of content (i.e., noema) and the act of experiencing (i.e., noesis).
- By understanding the noetic-noematic structure of an interaction, a designer will be able to specify the relationship between the experiential content and mental act leading to this content.
- We can intent mentally to auditory phenomena in two ways; pre-reflectively or reflectively, that is, incidentally and selectively.
- Actionality-modes which are translated into listening modes, are considered to be the root of auditory experiences.
- Listening modes can be identified in the way informants talk about their experiences (noemata), and experiences can be described by analysing the applied listening modes (noeses) and their noemata.
- The natural attitude is always present and can be described as our everyday attitude. Other attitudes co-exist with the natural attitude and can be described as analytic-reflective attitudes. For instance, do we interact with a song to analyse its musical structures, or to be entertained?

Summary

Findings in this chapter show that phenomenology offers a standardised way to express the variations found in everyday experiences and provides a theoretical approach for describing auditory user experiences.

In this chapter, I illustrated a phenomenological attitude towards experiences based on transcendental philosophical concepts and understanding. With this grounding, experiences are structured through our directness towards the world and described through the concept of *intentionality*.

I find the concept of intentionality as a promising foundation for user experiential research since this concept offers an apparatus with potentials to advance descriptive and analytic inquiries into user experiences.

Intentionality is structured by two mutually depended constituents: The noema and the noesis. Noema is the content of intentional acts, and the noesis refers to the type of intentional act.

The concept of intentionality not only has the potential to facilitate designers in effectively addressing user experiential occurrences, but also the potential of offering a way to identify experiential differences and similarities between people, or before the same person.

Intentionality refers to not only concrete events but also implicit events such as memories of previous experiences and imaginations. These intentional acts that are not based on present direct perceptions exist in the same inner time-frame as present direct perceptions and are therefore immediate present in the consciousness alongside with directly perceived objects. However, the ultra-short-term memories of just experienced events (e.g., retentions) and the immediate anticipations of our everyday actions (e.g., protentions) are always present in our engagement with the world and help us applying a coherent meaning to our present perceptions.

How we value experiences are highly depended on prior experiences, as well as our current engagement in the world, which governs not only our instant experiences but also our anticipations. Satisfying experiences are often a result of whether these anticipations are fulfilled, whether the experiences were better or worse than expected, and whether the anticipations initially were positive, neutral or negative.

A phenomenological description or analysis of auditory design and products is not a matter of corroborating the real qualities of the design, but a matter of describing the subjective experiences

and valuing of the design, that is, the noesis-noema structures and the valuing of these. This descriptive approach can be utilised through questions such as *How do the informants experience the auditory interface design? How are users valuing the content of these auditory experiences? How do these findings correlate with the designer's intentions?*

Another point made in this chapter is that the noetic structure in intentionality is not unidimensional, but consists of different actionality-modes of attending to an object. In the section "Intentionality and listening modes", I paralleled the actionality-modes to listening modes and argued for why the listening modes are the pivotal point in my proposed design tool. The applied mode(s) are influencing the noematic appearances, and are therefore considered as the root of subjective experiences. Four intentional modes were identified in this chapter. Two of them, the *perceptual* and *signitive-symbolic* intentional modes, were derived from Husserl's distinction between intentionality referring directly to the perceived object (in our case the sound object) and intentionality referring to the signitive-symbolic abstraction of the perceived object. The third intentional mode, the *embodied* intentional mode, was derived from Husserl and Merleau-Ponty's definition of operative intentionality and is defined as both reflective and pre-reflective (bodily) intentionality. Devices that mediates our listening has the potential of becoming a part of the operative intentionality when our interaction with the device is so fluent that it becomes "invisible" to us. Our listening experiences are fundamentally depended on the directness of our organs of hearing that shapes the perceptual acoustical field. Hearing-organs includes not only our physiological hearing organs but also audio-mediating and producing devices: We can only hear what the device is programmed to capture, mediate and (re)play. For instance, devices with omnidirectional microphones direct our listening differently than devices with one-directional microphones. Moreover, human listening can be mediated through several devices: A person listening to music through loudspeakers will only experience one mediation, whereas a person with hearing aids that listen to the same music through the same loudspeakers will experience two mediations; one through the loudspeakers and one through the hearing aids. Since digitally mediated sounds always add some distortion to the mediated sound, interaction designs have to take the number and quality of the mediation(s) into account when evaluating audio-based interfaces.

The last mode identified in this chapter is the *empathic* intentional mode, which is derived from the phenomenological description of intersubjective directness. The empathic directness towards

others is described as a part of our intersubjective communication. I extended this empathic directness to include non-subjective entities in the pre-given world, where an empathic listening mode is directed to a signified dimension of sounds. Since noemata of the empathic listening mode are not directed toward an intentional sound object derived from the perceived sound, the empathic listening mode is categorised as a variety of the signitive-symbolic listening mode.

Thus, the preliminary structure of the framework, as the phenomenological examination in this chapter has informed it, consists of four listening modes: An *embodied listening mode*, a *perceptual listening mode*, a *signitive-symbolic listening mode* and an *empathic listening mode*, where the latter is as a subcategory of the signitive-symbolic listening mode (see figure 11).

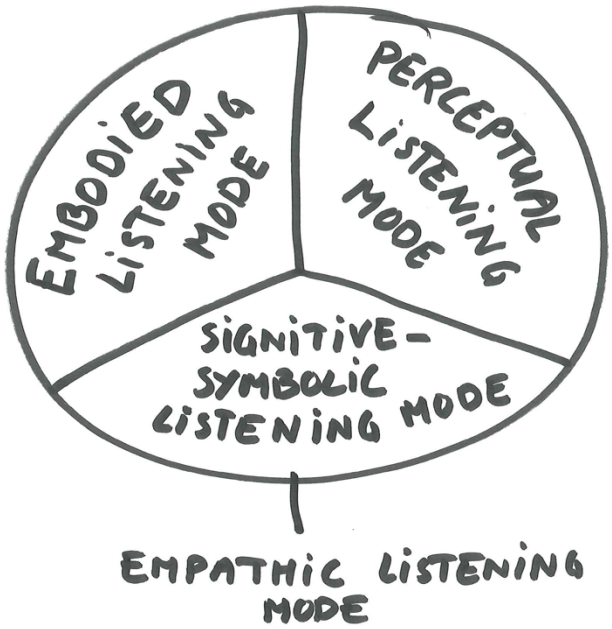

Figure 11: Embodied, perceptual and signitive-symbolic listening modes.

Focusing only on consciousness is insufficient since the self is not self-sufficient. Not only are we responding directly or indirectly to past events and future anticipations, but we also exist in a multitude of physical, social, cultural relations. Thus, how a sound appears in our mind does not only depend on our listening modes, but also on the outer horizon (such as the physical environment, the historical, political, social, and cultural context in which the sound is perceived) and inner horizon (e.g., attitude and prior experiences of the listener). For instance, the experience

of a digital conversational assistant is not only influenced by how we auditorily direct ourselves to the assistant's voice, but also on our personal experiences with similar assistants, our hearing organs, the acoustic quality of the assistant's voice and the soundscape in which the assistant is used (e.g., at home in quiet surroundings or outside in noisy urban settings).

In this thesis, the outer horizon is referred to as the external context and includes both physical and nonphysical factors. The physical factors are bodily orientation and movements, the spatiotemporal field, and the perceptual field. The nonphysical factors refer to socio-cultural, historical and political contexts. Figure 12 illustrates this division:

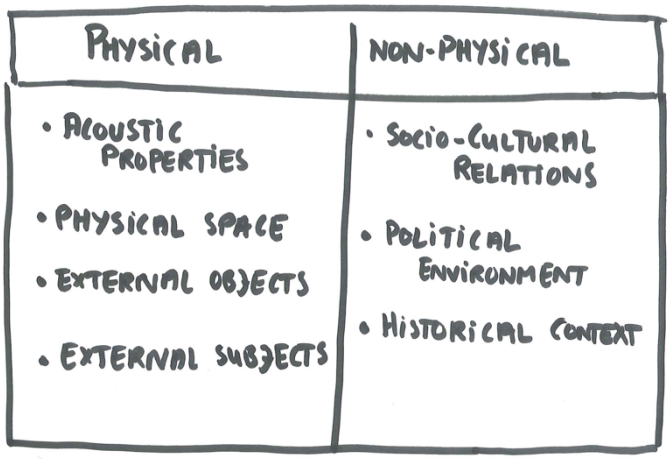

Figure 12: External contexts - physical and nonphysical.

In the present chapter, I also stated that the applied attitude affects the way we direct ourselves to the world. In the natural attitude, we predominantly direct ourselves in a practical tool-like fashion. Other attitudes direct our consciousness in more abstract and reflective ways. For instance, an analytic attitude may be more disposed to direct the listening focus to the structural qualities in a sound, and the phenomenological attitude questions the whole foundation of auditory experiences. In the current thesis, I differentiate between two overall attitudes: a natural attitude and an analytic/reflective attitude, where the natural attitude differs in the sense that it is always present and defines our everyday approach to the world.

The noetic act of listening is carried out in the sphere of perceived acoustic actualities, but not all sounds are attended to in an intentional way. Some perceived acoustic actualities are only noticed in the peripheral and act as background intuitions. Sometimes these background intuitions

move from the periphery of our perception and into intentional perception, and sometimes perceived objects turn into background intuitions. This change in focus sometimes happens incidentally and sometimes actively. As a result of this fluctuating nature of our focus, our listening focus cannot be explained in a dichotomous manner as either foreground or background, since the line between foreground and background is blurry. Particularly in everyday situations, our attention tends to change in many directions. For instance, when we drive a car with the radio on, we might find ourselves listening to the radio for a few seconds, then change our focus to the driving for some seconds and back again to the speaker, and so forth. It is only on special occasions, such as listening to a concert or analysing sounds, that our mind will stay focused on the same sound for a longer period. In my work, I refer to this kind of attention as the level of directedness towards a sound, going from inattentive to attentive that can be either incidental or selective. Investigations of the level of directedness should be conducted in the use-situation to get a valid result.

Moreover, our directedness is governed by not only external contexts but also internal contexts such as applied attitude and prior experiences. Thus, conditions such as familiarity with the perceptual field influence the level of directness. The less familiar we are, the more intense and focused our directness is. For instance, if we are travelling in unfamiliar places, we will be more directed to the sounds and their meaning, than when travelling in familiar places. Thus, experiential descriptions from first-time users of an audio product should ideally be separated from descriptions made by experienced users.

Through the phenomenological concept of intentionality, I argue that we can only focus on one instance at a time, that is, we can only attend to one noema at a time but with different intensity. However, we can apply different listening modes to shape this one noema.

Figure 13 illustrates my initial experiential framework developed from the findings in this chapter.

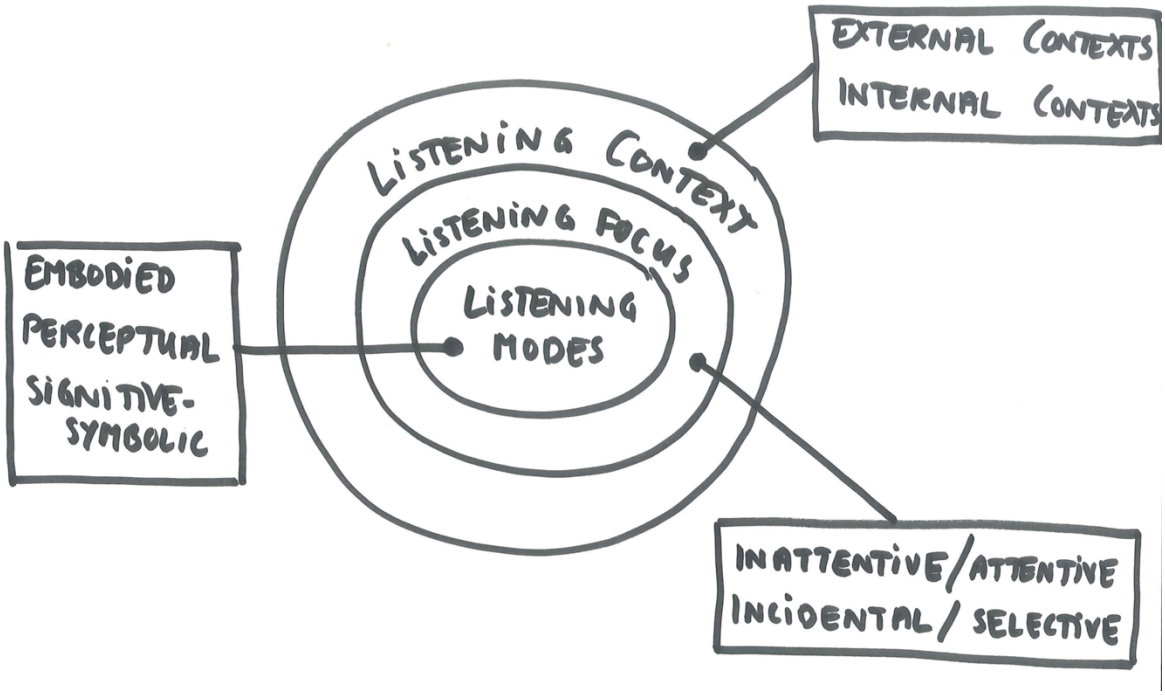

Figure 13: Components of the initial experiential framework.

The auditory experiential framework shows that listening is always contextual, that is, influenced by external and internal (i.e., internal conditions) contexts in which the listening takes place. The rings illustrate the relationship between the listening modes, listening focus and listening context.

Without a technical language and a formally agreed notation, user experiences can be complex to describe, analyse and discuss. With my proposed framework I want to move away from the natural attitude towards auditory user experiences that reduces listening to passive one-dimensional acts or reduces experiences to be solely a matter of either physical reactions to sound signals, psychoacoustic experiences, emotions, or semantics. Instead, my proposed descriptive experiential framework promotes a holistic view on auditory user experiences, offering a way to describe and analyse auditory experiential evidence through user's meaningful apprehensions of auditory phenomena. The framework facilitates a description, analysis and evaluation of auditory experiences, and provides a foundation to attached qualities to experiences. This approach is

founded in a belief that actionality-modes, and thus listening modes, are the fundamental structure of subjective experiences. Structuring experiences through listening modes that are derived from user's experiential articulations gives an overview of the noematic content of experiences and hence offers a way to assess experiential qualities and concerns.

A typical objective of scientific research is to make the investigations as objective as possible, where the researcher seeks to bracket his or her natural attitude. However, as I claimed in this chapter, the bracketing of the natural attitude is not possible, as it requires us to question everything we attend to and believe in. Phenomenological analysis can therefore never be based on bracketing of the natural attitude as such, but only on bracketing parts of the natural attitude. We cannot escape our natural attitude, but with an awareness of the presence of the natural attitude and an insight of what constitutes this natural attitude, we can, at our best, approach bracketing that is relevant to the type of inquiry we conduct. The proposed framework can, therefore, be considered as a tool to help designers and researchers bracketing their natural attitude towards auditory user experiences, where the act of listening too often been view in a one-dimensional fashion.

Since, the framework centres around listening modes, the framework will be advanced in the next chapter through findings from literature reviews of research into listening and listening modes that are predominantly found within the field of musicology.

5. From receptions to listening modes

In this chapter, I discuss the phenomenological concepts from the previous chapter and expand these with theoretical descriptions of listening practices and modes that views human listening practices from a holistic position. The findings will conclusively be synthesised into the complete version of the auditory experiential framework.

As mentioned in the previous chapter, listening is a fundamental concept in auditory experiences, which makes a comprehensive understanding of listening crucial in the quest of forming a tool for investigating auditory user experiences. Barry Truax also emphasises this central position listening in his book *Acoustic Communication*:

> "Listening is the key issue in communication via sound because it is the primary interface between the individual and the environment. It is a path of information exchange, not just the auditory reaction to stimuli" (Truax, 2001, s. xviii)

The theoretical inquiry into listening practices and modes found in this chapter is rooted in musicology since musicology maintains a long tradition of conceptualising listening practices.

From typologies to listening modes

Musicology was the first discipline to pay genuine attention to the human way of listening that goes beyond psychophysics and biology. Traditionally, listening practice descriptions within musicology were typologically structured and used as a way to group people by listening type. The earliest known distinction was made in the late-18th century in Germany and divided music listeners into *Kenner* and *Liebhaber*, that is, expert listeners and listeners who listen for enjoyment. This basic distinction is still applied today within musicology (Lilliestam, 2013, s. 3).

In the 1060s, the German philosopher Theodor W. Adorno presented a listener typology that has been discussed often, because of its elitist viewpoint (Lilliestam, 2013). He divided listeners into eight different groups, where the *experts* were considered as the highest ideal, and the *musically indifferent*, *unmusical* and *anti-musical* as the lowest. He explained, though, that these listener types do not exist in a pure form and no one is precisely one type, but a mix of different types.

Knut Wiggen (1927-2016), a Norwegian composer who was highly inspired by Schaeffer's phenomenological approach to music, parted with the typological view in the early 1970s when he took a different approach to the listening act (Rudi, 2018). Instead of dividing people into listening types, he operated with listening techniques consisting of four different techniques (Lilliestam, 2013, s. 3). The first listening technique is *Listening to music as a sounding backdrop*, which is a kind of background listening; the music played is familiar and perceived as a safe companion rather than the focus of attention. *Intoxicated by sound* is the second listening technique, which describes a state of listening where one has so emerged into the music that everything else around him or her vanishes. *Craftmanship listening* is the third technique and refers to listening to compositions and structures in music. The fourth and final listening technique is called *Contents listening* and describes emotional listening (Lilliestam, 2013, s. 3-4). Wiggen's listening techniques seem to point in two very different directions: *Listening to music as a sounding backdrop* and *Intoxicated by sound* can be related to inattentive and immersed listening focus, whereas *Craftmanship listening* and *Contents listening* express dimensions of a sound to which we can be directed. *The definition of Craftmanship listening* is a direct perception of the music, and correlates with the perceptual listening mode identified in the previous chapter, but can also be considered as kind of analytic attitude. The perceptual listening mode does not imply certain types of sounds but refers to both crafted and naturally occurring sounds that are intended to be either selectively or incidental. Even though Craftmanship listening indicates listening to musical structures, *Craftmanship listening* is considered equivalent to the perceptual listening mode mentioned in the last chapter. *Contents listening* correlates with the signitive-symbolic listening mode that was identified in the previous chapter. A bodily directness to music listening that can be found in feeling the music as can be experienced when dancing and playing music is not addressed in his listening concept.

Rösing (has been mentioned before) also refers to listening as typological personalities but specify them as receptions rather than listening *modes. The concept of receptions is taken from the German music theorist Herman Rauhe (Rösing, 1984, s*. 133). These receptions parallel my definition of listening modes, and they are organised on an *inattentive-attentive* scale of listening[39]. This scaling is based on what attention level he defines as fitting each reception type. Rösing's listening receptions move from the bodily *motoric listening*, which he places on the inattentive part of the attention scale, and up to the *structural reception*, found on the highest attentive level. Between these two extremes, we find *imaginative reception*, *emotional reception*, *empathic reception* and *subject-oriented reception*, each operating within a pre-defined level of attention. The imaginative and emotional receptions are found in the lower end on the attention scale, whereas the empathic and subject-oriented receptions are found on the higher end on the scale of attention (Rösing, 1984, s. 133-135). Rösing's way of coupling attention with receptions will not be discussed here; I will only attend to the distinction he makes between the different receptions, particularly interesting is the distinction he makes between the emotional and empathic reception, and his mentioning of an imaginative reception. The emotional reception refers to a pre-reflective bodily directness towards the emotional dimensions of music, while the empathic reception refers to a reflective directness to the emotional aspects of music. However, the difference between the emotional and empathic reception can also be found in the distinction between perception and effects. Emotional reception seems to be pointed at emotional reactions to sounds, whereas the empathic reception points at the emotional aspect in a sound. The definition of emotional reception seems to correlate with Augoyard & Torgue's definition of emotional listening. Augoyard & Torgue describe sounds as having immediate emotional power that affects us in everyday situations (Augoyards & Torgue, 2005, s. 11). Augoyard touches this emotional aspect of listening in his "Pas à pas" (Augoyard, 2007), where he investigates the auditory experiences of residents living in Grenoble. Through interviews, he explored the routes made by these residents of their trip forth and back to the store, their friends, etc. In Augoyard's analysis, he finds environments that residents avoid because they do not *feel* at home there because of the character of the acoustic profile of the environment. According to Augoyard, one senses an acoustic environment when you are feeling excluded from that environment. In contrast, if you are the dominant part (i.e., a member of the

[39] See the section "Sensorial experiential focus".

acoustic profile), you do not consider the space as a specific acoustic domain, which takes us back to Jacob Kreutzberg's concept of acoustic territories mentioned in chapter four (see page 93). Thus, for Augoyard, acoustic territories can be regarded on an emotional level, where it is only registered if being the excluded part (e.g., feeling like a stranger or by sensing negative feelings).

In contrast to Rösing, I include only include the empathic way of listening in the auditory experiential framework. The empathic listening mode refers to a reflective directness towards the emotional dimension of a sound, whereas the emotional listening mode refers to a pre-reflective and bodily reaction. As mentioned earlier, the empathic listening mode is regarded as a subcategory to the signitive-symbolic listening mode.

Due to the lack of a definition of the subject-oriented reception, I will not distinguish between the empathic and subject-oriented reception in this current thesis. Rösing's structural reception is similar to Wiggen's *Craftmanship listening* and is, therefore, in a similar way, equivalent to the perceptual listening mode. The imaginative reception refers to an abstract intended to sound object, that is, an object that does not reside in the external physical world. Thus, it cannot be regarded as a signitive-symbolic listening mode that rests upon direct perceptions of acoustic actualities. When musicians go through a song mentally, when one is having a mental conversation with oneself, memories of a song and the presence of tinnitus are examples of imaginative listening. Thus, Rösing's theory of reception adds one extra dimension to the model: the imaginative listening mode (see figure 14).

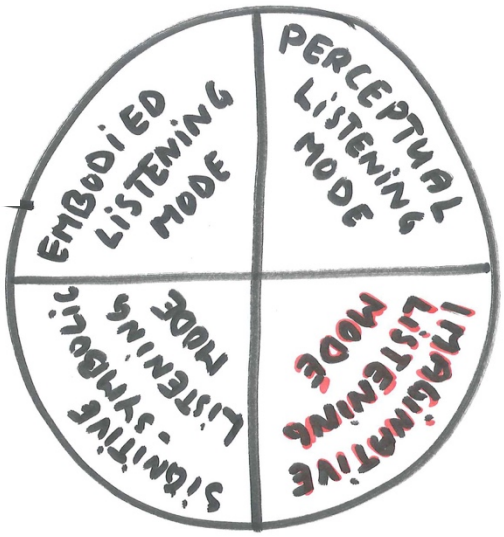

Figure 14: The two new listening dimensions (highlighted with red).

Within interaction design, William Gaver, a professor in design at the Interaction Research Studio at Goldsmith University, proposed a dichotomous description of listening practices by dividing our way of listening into either an everyday listening mode or a musical listening mode (Gaver, 1989). Everyday listening signifies our naturalistic listening tool-like attitude towards listening. In contrast, musical listening correlates with Wiggen's *craftmanship listening* and Rösing's *structural reception*, where we attend to the sound as a piece of music to listen to in a focused way. Hence, Gaver's approach to listening behaviour is more comparable to the phenomenological understanding of attitude than listening modes.

Listening modes

Pierre Schaeffer was the first to define listening in listening modes. In his "Traité des Objets" (2017), Schaeffer introduces a theoretical account of listening practices in a four-dimensional matrix of possible listening modes (see figure 15).

As with Wiggen, Schaeffer's four listening modes involve both a level of attention and dimensions of sounds to which our attention can be directed. The four listening modes are *Ouïr*,

Écouter, *Entendre* and *Comprendre*, and they have been translated into *to perceive*, *to listen*, *to hear* and *to understand* in the English edition of "Traité des Objets Musicaux: Essai interdisciplines" (Schaeffer, 2017).

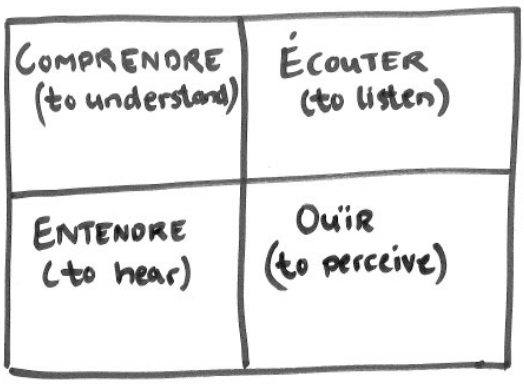

Figure 15: Schaeffer's four listening modes

Ouïr (to perceive) is defined as an inattentive and pre-reflective manner of listening and thus correlates with Husserl's passive perception: In line with passive perception, we direct to the sound in a bodily manner, without the involvement of the ego. Ouïr is not operating on an unconscious level, but operates in the fringe of our consciousness as background intuitions, or, as a minimum, operates on a subconscious level:

> "What I perceive aurally is what is given to my attention […] But for all that, to perceive aurally is not 'to be struck by sounds' coming to my ear without reaching my consciousness." (Schaeffer, 2017, s. 74-75)

According to Horowitz (Horowitz, 2012), this bodily reflexive way of directing towards certain sounds may be the reason why we are not driven insane by all the sonic actualities that surround us since it subconsciously chooses what to hear and what to ignore.

As with Husserl and Merleau-Ponty's operative intentionality, Schaeffer regards ouïr as being fundamental for our listening, since the vast majority of the acoustic actualities we register throughout our day are perceived in this pre-reflectively way. Since ouïr is the entry mode to all our listening experiences, it would not be possible to prevent this kind of listening, unless we are

physically unable to detect acoustic signals. As emphasised by phenomenologists, it is impossible not to be conscious of something. Thus, we are always listening to something, even when our listening is considered inattentive. The only way of observing operative intentional acts is through bodily manifestations, which was also emphasised by Merleau-Ponty in the previous chapter. Although we are inattentive towards the background sounds, we do still register to them. For instance, if background sounds suddenly increase in intensity, we automatically raise our voice, and if a background hum suddenly stops, we often sense this change (Schaeffer, 2017, s. 74-75). According to Schaeffer, these automatic registrations indicate that seemingly unremarkable sounds are somehow remarked and stored fleetingly in our mind:

> "But it is true that I can only ever become aware of the backdrop of sound indirectly, by reflection or memory. I hear the clock strike. I know it has struck already. I hastily reconstruct in my mind the first two strokes, which I had perceived aurally, establish which one I heard as the third, even before the fourth strikes. If I had not wanted to know the time, I would not, in fact, have known that the first two strokes had reached my consciousness." (Schaeffer, 2017, s. 75)

When moving around in a sonic landscape, we will soon discover the difficulty if not impossibility, in not foregrounding some sounds over others, which brings us to Schaeffer's next listening mode *entendre* (to hear). *Entendre* also refers to our listening focus but represents an attentive listening to sounds. According to Schaeffer, the etymological meaning behind *entendre* is *tending towards*, whereas the modern use of *entendre* in the French language is to passively perceive sounds by the ear (as with "to hear" in English). By using the term entendre, Schaeffer aimed to reclaim the original meaning behind *entendre* (Schaeffer, 2017, s. 103). Our attention is never equally spread out across all sonic actualities, as we also discussed in the last chapter, but prioritised voluntarily or involuntarily. For example, a drummer focusing on the rhythm of a song when practising is voluntarily prioritising the rhythmic sounds in the song, and a person who has a hard time ignoring the trains passing by his house while trying to sleep at night is involuntarily prioritising the sounds produced by the trains. Schaeffer explains this shifting of attention as not only a matter of psychoacoustic qualities such as loudness, timbre and pitch but is also determined by more subjective factors such as personal background and experiences:

> "[…] different listeners gathered around a tape recorder are listening to the same sound object. They do not, however, all hear the same thing; they do not choose and evaluate in the same way, and insofar as their mode of listening inclines then toward different aspects of the sound, it gives rise to different descriptions of the object. These descriptions vary, as do the hearing, according to the previous experience and interests of each person. Nevertheless, the single sound object, which makes possible these many descriptions of it, persists in the form of a halo of perceptions, as it were, and the explicit descriptions implicitly refer back to it." (Schaeffer, 2017, s. 83)

Schaeffer's definition of entendre equals Husserl's definition of direct perception, and Schaeffer's description of ouïr and entendre can, therefore, be related to the perceptual listening mode.

From these two listening modes, we now move over to Schaeffer's other two listening modes: *Écouter* (to listen) and *comprendre* (to understand). Whereas *entendre* and *ouïr* only implicitly refer to an embodied and perceptual listening mode, *écouter* and *comprendre* can be explicitly defined as a signitive-symbolic way of listening. Écouter refers to a utilitarian listening practice, in which sounds are treated for their instrumental qualities which, according to Schaeffer, is predominantly applied in our naturalistic everyday attitude (Schaeffer, 2017) (Lilliestam, 2013) (Gaver, 1989). This indexical way of listening can, as with the empathic listening mode, be considered as a subset of the signitive-symbolic listening mode, since the listening focus in écouter is on the sound structures, but on the object or event that produces the sound. Hence, the noema is not a sound object, but a mental occurrence of the sound-producing object or event:

> "Here to listen is still to focus, beyond the immediate sound itself, on something else than it." (Schaeffer, 2017, s. 76).

In this listening mode, we make insinuations about the source, such as the speed of the car, the direction it is heading, and perhaps the size and type of car, based on the qualities of the intentional sound itself.

In this mode, the sound functions as an indicator, or more precisely a tool, for identifying and describing the sound source that helps us navigate the physical world (Schaeffer, 2017, s. 81-82).

Comprendre (to understand) is the fourth and last listening mode in Schaeffer's four-dimensional matrix. *Comprendre* is a listening mode that attends to the symbolic dimension of a sound. In this mode, the link between the sounding object and sound object is culturally defined, whereas the link between the sounding object and sound object in écouter is causally defined. Thus, the noemata found in the comprendre listening mode are abstract phenomena, whereas the noemata found in the écouter listening mode refers to experiences of concrete objects or events. As with écouter, this mode of listening can be considered as a subset of the signitive-symbolic listening mode.

Subjective and objective listening modes

As mentioned in the previous section, the listening modes écouter and comprendre attend to intentional objects that are not sound objects, whereas ouïr and entendre refer to sound object noemata. Schaeffer makes a distinction between these two ways of referring in which he respectively labels as objective and subjective. Écouter and comprendre are considered as objective modes since they refer to a type of noemata that can be shared in the external world through conventions. Thus, these noemata they are shaped by the physical properties and cultural conventions since they are eidetic outlines of objects and conventions that exist in the external world; a sound of a car refers to a car that can be equally experienced by other people, and the semantic meaning behind police sirens is also a collectively shared understanding in a given cultural or social group. Ouïr and entendre, on the other hand, refer to individual experiences that cannot be collectively shared. Thus, experiences related to subjective listening modes depend solely on the individual listener, experiential background and physical capabilities.

This insight is very interesting from an evaluation perspective since it implies that descriptions of experiences made in the subjective listening modes, such as the embodied and perceptual listening modes, can be much more difficult to apprehend from a third-person perspective than those made in the objective signitive-symbolic listening modes that can benefit from collectively shared experiences.

To specify the context in which these two categories of listening modes predominantly take place, Schaeffer sometimes refers to them as the ordinary listening modes and specialised listening modes. The ordinary listening modes refer to the objective listening modes, and the specialised listening modes refer to the subjective listening modes. The reason why Schaeffer denotes objective listening modes as ordinary listening modes is because he believes that these are the most commonly applied listening modes in our everyday listening situations. Subjective listening, on the other hand, requires specialised listening skills and vocabularies that have to be learned, which is why he denotes these as specialised listening. According to Schaeffer, specialised vocabularies are difficult to share between different specialised groups, because of their different way of attending to sounds:

> "The same galloping horse will be heard by them [acoustician and musician] in very different ways. Immediately, the acoustician will have an idea of how the physical signal is made up (frequency band, fading due to transmission, etc.); the musician will go spontaneously to the rhythmic groups […] in each of these different listener's consciousness, the raw or qualified sound object is perceived or analysed quite differently on each occasion. So, it is not surprising that misunderstandings tend to arise among such skilled people […] But don't they hear the same sound? Certainly, it cannot be denied that the same physical signal reaches ears that we supposed to be identically human, potentially alike, but their perceptual activity, from the sensory to the mental, certainly does not function in the same way " (Schaeffer, Treatise on Musical Objects: An Essay Across Disciplines, 2017, s. 88)

Schaeffer argues that a specialised ear is often trained to hear certain things in an acoustic signal, and it, therefore, takes an ordinary (untrained) ear to hear new aspects of a sound. The specialised ears are often blind to other aspects of the acoustic signal in which he or she has been trained.

This division between objective and subjective listening modes parallels with Gaver's distinction between everyday listening mode and musical listening mode, and Husserl's naturalistic and philosophical attitude.

Abstract and concrete listening modes

Schaeffer also emphasised a dependency between *comprendre* and *entendre*, and between *écouter* and *ouïr* (Schaeffer, 2017, s. 85). According to Schaeffer, the listening mode *écouter* cannot be practised without perceiving the raw sound signals through the listening mode *ouïr*, and the listening mode *comprendre* depends on the listening mode *entendre*; to obtain the meaning a qualified listening to the sound must be applied.

By using the same arguments as Schaeffer, I consider listening to sound sources (*écouter*) and unfolding the meaning behind a sound (*comprendre*) to be impossible without the ability of perceiving acoustic signals (*ouïr*) and without focusing on specific sounds (*entendre*): I believe that one cannot listen (*écouter*) without attending actively to a sound (*entendre*) since the qualities of a sound have to reveal themselves in order to operate as an indicator. Moreover, I believe that *ouïr* is a requirement for *écouter* since there will be no sound source to register without perceiving the acoustic signals that belong to that sound source. However, it is my claim that none of the listening modes can be applied without perceiving the raw sound signals (ouïr), and *comprendre* and *écouter* cannot be practised without applying the listening mode entendre. Thus, *écouter* depends on both *ouïr* and *entendre*, and *comprendre* also depends on both *ouïr* and *entendre*.

For Schaeffer, *écouter* and *ouïr* represent a natural (concrete) way of listening since experiences made through these listening modes are directed to external entities that are not depended on cultural knowledge to decode. *Comprendre* and *entendre* are referred to as abstract listening modes since they are based on cultural conventions. Schaeffer describes his listening modes as stages in a listening process, starting from the most concrete, *ouïr*, through *entendre* and *écouter*, and ending with the most abstract, *comprendre*. However, he also argues that his presented listening modes should never be view as a chronological process in everyday listening situations. However, this chronological order is, according to Schaeffer, only relevant for descriptive or analytic purposes (Schaeffer, 2017, s. 84-85).

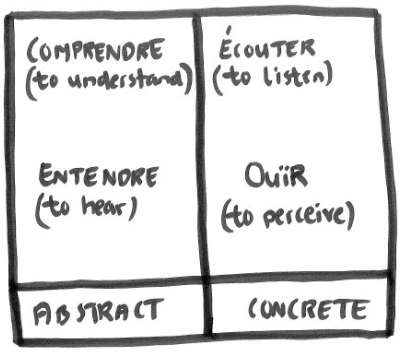

Figure 16 Abstract vs concrete listening modes

From a phenomenological perspective, causal references are just as abstract as symbolic references, since they both are signitive abstractions of the perceived object. Phenomenologically, ouïr and entendre would be the most concrete references, since their noemata are not signitive abstractions of the intended to sound. As Husserl and Merleau-Ponty argue, our bodily and perceptual directness is our most direct and genuine engagement with the world. Thus, in this thesis, the dependency between the listening modes will be described as a dependency between the embodied-perceptual and signitive-symbolic listening modes, where the signitive-symbolic listening modes are dependent on the embodied-perceptual listening modes. This interpretation makes the concrete listening modes as a prerequisite for abstract listening modes; the signitive-symbolic listening mode cannot be carried out without the engagement of the embodied and perceptual listening mode, and the imaginative listening mode cannot be carried out without prior occurrence of the perceptual and embodied listening.

Chion's three listening modes

Highly inspired by Schaeffer's theoretical approach to sound and listening, Michel Chion, a French composer and filmmaker, identifies three modes of listening, which are causal listening, semantic listening and reduced listening:

> "When we ask someone to speak about what they have heard, their answers are striking for the heterogeneity of levels of hearing to which they refer. This is because there are at least

three modes of listening, each of which addresses different objects. We shall call them *causal listening*, *semantic listening*, and *reduced listening*." (Chion, 1994, s. 25)

Causal listening refers to a listening mode directed to the source of the sound and thus has parallels with *écouter*. As Schaeffer, Chion describes this listening mode as the most common listening mode found among people. In his role as a filmmaker, Chion also finds the noemata of this listening mode as easy to manipulate:

"We must take care not to overestimate the accuracy and potential of causal listening, its capacity to furnish sure, precise data solely on the basis of analyzing sound. In reality, causal listening is not only the most common but also the most easily to influenced and deceptive mode of listening [...] Let us note that in cinema, causal listening is constantly manipulated by the audio-visual contract itself [...] Most of the time we are dealing not with the real initial causes of the sounds, but causes that the film makes us believe in." (Chion, 1994, s. 26,28)

Through the properties of a sound, the noema of the listener can easily be changed. Manipulating sounds to create specific noemata in listeners is not only common among filmmakers but equally widespread among sound and product designers. Particularly within the car industry, we find these manipulations of the sound to construct specific inner pictures of the characteristics of the car (Bijsterveld & Krebs, 2013).

According to Chion, causal listening operates on three levels: on an individual level, a group level, and an unknown level. On the individual level, we recognise specific people, events or objects through the sound (Chion, 1994, s. 27). On a group-level, we register a category of people, objects or events. On the unknown level we are not able to determine the source, but still sense the properties of the source (e.g., we hear something is moving towards us, we hear a scraping sound of some small creature).

The semantic listening mode refers to listening that directs itself to the code or message of the perceived sound. Semantic listening is not focused on the acoustic properties of the sound but the denotative and connotative aspects of the sound which range from understanding the spoken

language to the interpretation of sonifications and symbolic meanings (Chion, 1994, s. 28). Chion's semantic listening is equivalent to Schaeffer's comprendre.

The last listening mode, reduced listening, is directly taken from Schaeffer's equal term. Inspired by the phenomenological reduction, Schaeffer introduced the concept of reduced listening. In reduced listening, a phenomenological reduction is applied to the listening, that is, bracketing the natural attitudes to get into the essence of a sound. Thus, reduced listening refers to listening to the inherent qualities of the sound itself without focusing on its signifying or causal dimensions. Chion argues that the reduced listening mode is the most challenging listening mode to be evaluating:

> "A session of reduced listening is quite an instructive experience. Participants quickly realize that in speaking about sounds, they shuttle constantly between a sound's actual content, its source and its meaning. They find out that it is no mean task to speak about the sounds in themselves, if the listener is forced to describe them independently of any cause, meaning, or effect." (Chion, 1994, s. 29)

Chion's semantic listening mode and causal listening mode is considered as a subcategory of the signitive-symbolic listening modes in my framework.

Stockfelt's modes of listening

The music theorist Ola Stockfelt, who writes on music listening and soundscape, has developed a theory of music listening from a value-free perspective, that is, without promoting one listening mode over another, just like Schaeffer, Wiggen, Gaver and Chion. He rejects the idea of the specialised, educated and focused listening style being the only correct way of listening, and argues that all kinds of listening can be a correct way of listening (Stockfelt, 2007). Moreover, he concludes that the idealised expert listener hardly exists in real life (Willshire, 2017, s. 33). Stockfelt describes context as being highly influential on our listening experiences. The way we experience music changes when the context change. Hence, new listening situations create new meanings. According to Stockfelt, music research has often been centred on focused listening, and not on everyday listening situations where the influence of context is more evident. According to Stockfelt, everyday listening has often been ignored even though the vast majority of music

listening is done in what he calls the *everyday mode of listening* (Stockfelt, 2007, s. 132), which I will refer to as the everyday listening attitude. This strong focus on contextual factors differentiates Stockfelt from the other music theorists mentioned in this chapter.

Stockfelt uses the term modes of listening as a way to describe the different ways in which a listener can listen to music. He exemplifies the different ways one can listen to music, and the effect context, mood and environment have on listening experiences with a small anecdote from his own life:

> "Towards evening, I am totally exhausted, but can finally sink into the seat and relax. The roar of the engines and the hiss from the vents is almost deafening. Under normal circumstance, I detect those sounds, but now they give me the marvellous confirmation that I have made it – I have finally got past all those unexpected and absurd obstacles that forced me to run around and around, all day, in the heat, from office to office and from airport to airport, even though I had my reservation and was ready to depart I the morning. Between this buzz and the noise from fellow passengers, mad individual flute tones find their way to me, tones that further confirm my impression that I have finally reached a place where I can relax. It takes a few minutes before I can even muster the attention to listen to what is actually being played: it is the first movement of Mozart's Symphony no. 40 'Great G-minor,' in an arrangement for flute soloist and some kind of rock group. The flutist seems totally unengaged; as do the other musicians when it is even possible to distinguish what they are playing […] As long as I wasn't listening closely, it was perfect music for the situation, but now I start to be both irritated and interested. and not at all home anymore." (Stockfelt, 2007, s. 88)

As we see in the above quote, listening experiences depend on the music genre, attention level, the context it is being played in, and what other activities the listener is submerged in. In the above quote, we find the perceptual and signitive-symbolic listening mode applied; we see the change from inattentive listening to attentive listening and a change from Gaver's definition of everyday listening to a musical listening. Thus, Stockfelt's definition of modes of listening is more general than the listening theories currently presented in this thesis, since it embraces not only our

directedness to sound but also our listening situation, listening competencies, listening strategy and musical genres. Stockfelt's broad definition might explain his claim of the existence of an infinite number of listening modes (Stockfelt, 2007, s. 89). To be able to distinguish between his definitions of listening modes from mine, I will consequently refer to his definition as *modes of listening*, whereas my definition is referred to as *listening modes*.

According to Stockfelt, there exists an infinite number of modes of listening, but people only have a finite set available in any specific situation, and only a small part of these available modes are adequate for a given listening situation. The choice of mode of listening is restricted by the selection of modes we have at disposal, the music genre, the appropriateness of the modes in a given situation (i.e., environmental, social and historical situation), and strategies of the listener, which is illustrated in figure (see figure 17).

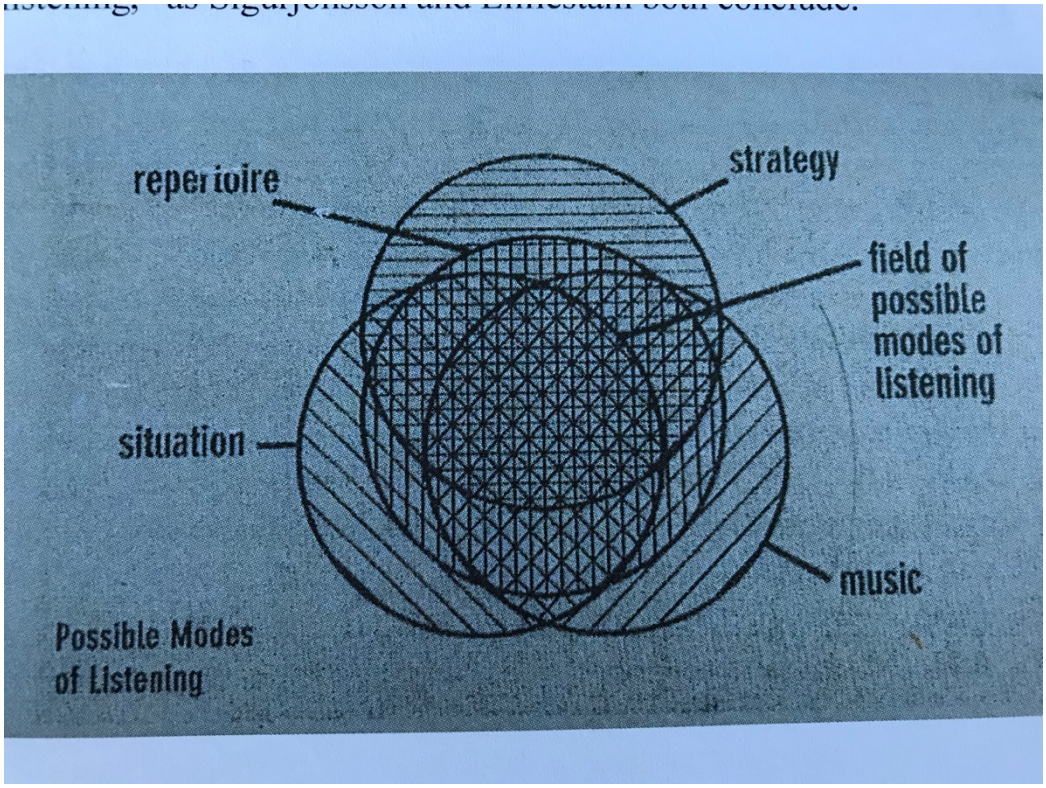

Figure 17: What restricts modes of listening (Stockfelt, 1997, 132)

Stockfelt states that the selection of modes of listening we have at our disposal varies from person to person and is depended on our inner and outer horizon. His definition of the field of possible listening modes is equivalent to Husserl's perceptual field that is the set of possible perceptions.

Stockfelt also states that the horizon of the listener can be considered as listening competencies (Stockfelt, 2007, s. 92):

> "The mode of listening a listener can adopt is in this way limited by the competencies in modes of listening that he or she possesses or can develop in a given situation." (Stockfelt, 2007)

Thus, our listening competencies are not something that only can be learned through professional training, but is also a result of our everyday listening where we learn to processes what is heard in specific ways. In our everyday life, we learn how to navigate in different acoustic environments. We also learn what meanings and functions to attach to the heard sounds and what actions are appropriate in the different listening contexts. Some sounds and musical interpretations are globally accepted, either because of global propagations through media or because of sound events that are universal, whereas others are limited to the individual or small local groups (Stockfelt, 2007, s. 89).

As illustrated in figure 17, our mode of listening depends on the situation, which refers to external phenomena and conventions. The listening situation can restrict our ability to choose the desired listening mode. For instance, when viewing a film in a cinema, our desire to follow the conversation in the film might be prevented if the person next to you is eating crisps. Moreover, visual phenomena may guide the listening focus (e.g., when a spotlight at a concert focuses on the guitar player, we tend to listen to the guitar over the other instrument), and loud or unusual sounds also have the ability of attracting a listener's attention (e.g., sirens or an unusual voice). As with Schafer, Stockfelt considered environments with too many competing sounds as having the potential to ruin a listening experience where we end up focusing on the most significant sounds rather than what is important (Stockfelt, 2007, s. 89).

The influential factors on our choice of modes of listening are not only made through external physical factors as the above examples suggest (i.e., leaving out noise or having to concentrate on external matters) but are equally influenced by social conventions. For instance, it is not appropriate to take on headphones to listen to private music on one's portable music player when being in a conversation with other people. He furthermore argues, that in everyday listening, the listening

situation has a more significant influence on our listening mode, than the genre or style of music we listen to:

> "[…] one can even assume that daily listening is often more conditioned by the situation in which one meets the music than by the music itself […]" (Stockfelt, 2007)

Stockfelt also argues that focused listening is challenging to apply for longer periods, no matter how good the listening situation is.

According to Stockfelt, listeners may choose what modes of listening to adopt and develop, but the majority of our adaption of modes of listening happen subconsciously throughout our life (Willshire, 2017, s. 33). Our choice of modes of listening to be used in any specific situation is also something that often happens unconsciously. Often, it is when we encounter problems in our listening that we start to negotiate what mode of listening that is the most appropriate one. To apply a phenomenological terminology, modes of listening are learned throughout life, and how we apply them will eventually become an operative act (i.e., a habit). The mode of listening we apply is, therefore, often done pre-reflectively, and our choice of modes often only become intentional when we experience a breakdown or are placed in unfamiliar listening situations.

Summery

Even though the auditory experiential dimensions are overlapping and mutually affecting each other, sometimes pre-reflectively and other times with our full awareness, the categorising of listening modes, listening focus and listening strategies in this chapter solely serve as means for understanding and describing auditory experiential structures. The idea is that this specification can be applied as a guide and vocabulary in the design, analysis and evaluation of auditory interfaces.

We find listening so immediate and obvious that what we hear is often readily accepted without any questions or reflection on the underlying experiential structures that govern the listening:

> "It has been my experience in teaching this subject [acoustic communication] that by simply drawing attention to the listening process, most people quickly realise how little they know about it and how often it is ignored" (Truax, 2001, s. xx)

In this chapter, I have investigated ways to describe auditory experiences through our listening stance by synthesising phenomenological concepts with theories of listening practices found in musicology.

Through Rösing's theory of listening reception, we were introduced to the *imaginative listening mode*. The noemata shaped by the imaginative listening mode such as inner conversations, imagined sounds and memories of sounds are not derived from directly perceived sounds in the factual world.

Schaeffer was the first to introduce the concept of listening modes, which he presented as a process-like four-dimensional matrix consisting of *ouïr*, *entendre*, *écouter*, and *comprendre*. The first two modes described two different levels of attention that can be applied when listening to sounds, whereas the latter two belong to the Husserl's signitive-symbolic listening perceptual mode. In his theoretical approach to listening modes, Schaeffer divided listening modes into either objective or subjective listening modes depending on their personal or collective characteristics. The objective listening modes refer to the listening modes where the noemata are collectively shared significations of the perceived object, whereas the subjective listening modes refer to listening directed to noemata that can only be experienced on a personal level. According to Schaeffer, objective listening modes are often easy to articulate since they refer to collective shared object and symbols. In contrast, the subjective ones are more difficult to articulate unless we have learned a domain-specific and specialised language for articulating sounds. Inspired by Schaeffer's description of listening modes being either concrete or abstract, I divided listening modes into the embodied-perceptual listening that are modes directly engage with the perceived sound and signitive-symbolic listening modes which are those directed to the signifying aspect of the perceived sound. Based on this differentiation, the dependency between listening modes can be described. The signitive-symbolic listening modes are dependent on the embodied-perceptual listening modes, that is, the signitive-symbolic listening mode cannot exist without the presence of the embodied-perceptual listening modes: We cannot direct ourselves to the signifying quality of a

sound without first directing ourselves to the sounds themselves. Thus, the embodied-perceptual listening modes are always present in our auditory experiencing, and will therefore always influence our auditory experiences. Chion's three listening modes - *semantic listening*, *causal listening* and *reduced listening* - are highly inspired by Schaeffer's theoretical approach, where the semantic listening mode refers to Schaeffer's *comprendre*, the causal listening mode refers to Schaeffer's *écouter*, and the reduced listening refers to Schaeffer's reduced listening mode. Chion's semantic listening mode and causal listening mode (i.e., Schaeffer's *comprendre* and *écouter*) are applied as subcategories to the signitive-symbolic listening mode in my experiential framework.

In his definition of listening modes, Stockfelt defined the listening situation, listening strategy, listening focus and musical genre as determining the choice and character of the applied listening mode(s). Listening situation refers to external and internal contexts such as the physical sphere, prior experiences, sociocultural conventions and cultural ideologies, and listening strategies refers to the set of applied listening modes. In the case of auditory interaction design, the term musical genre can be translated into auditory interface genre, and each auditory interface genre requires specific kinds of listening modes. For instance, sonification and audiobooks necessitate a semantic listening mode, background music in games is often designed for the emotional, empathic and perceptual listening modes and loudspeakers aim at supporting the embodied and perceptual listening modes. Consequently, a designer needs to understand the repertoire of possible modes in the given listening situations to create designs that meet the user's expectations and listening behaviour.

In the next chapter, the experiential framework and the first version of the model will be presented.

6. From an experiential framework to the EPSI-model

"There is nothing more practical than a good theory" (Lewin, 1951, s. 169)

Throughout the last two chapters, I have inquired into experiential aspects from a phenomenological standpoint and extended the result with theories of listening practices found within musicology. Auditory experiences were defined through listening modes that are grounded on Husserl's concept of actionality-modes and noetic-noema structures.

However, in order for the experiential framework to be useful as a practical tool in the design process, it should be presented in a more straightforward and explanatory way. One way of doing this is to think of the framework as a tool for identifying value-characteristics of auditory experiences. Phenomena are, as pointed out by Husserl, not just experienced as mere objects, subjects or events, but also mediated through a valuing process. Thus, in the current chapter, I will turn the experiential themes that were developed in the last two chapters into a descriptive model that can be applied as a tool for evaluating and analysing auditory user experience. The objective of the model is to offer a designer an overview of the human listening structure that can be applied as a guide in various ways and design situations. This process demonstrates how theoretical concepts can be utilised as a practical design tool for both design practitioners and researchers. It should be noted that the listening modes that have been identified are based on tentative work and thus should be seen as a preliminary investigation into how a phenomenological interpretation of experience can facilitate a more comprehensive understanding of auditory user experiences.

The Experiential framework

The findings from the previous chapters resulted in four auditory experiential dimensions: an *embodied listening mode*; a *perceptual listening mode;* a *signitive-symbolic listening mode*; and *an*

imaginative listening mode. The signitive-symbolic listening mode was also divided further. The subcategories of the signitive-symbolic listening mode are the *casual listening mode*, *semantic listening mode* and *empathic listening mode*. The preliminary outline for the experiential framework is illustrated in figure 18, showing the seven auditory listening modes and their dependency on context and listening focus.

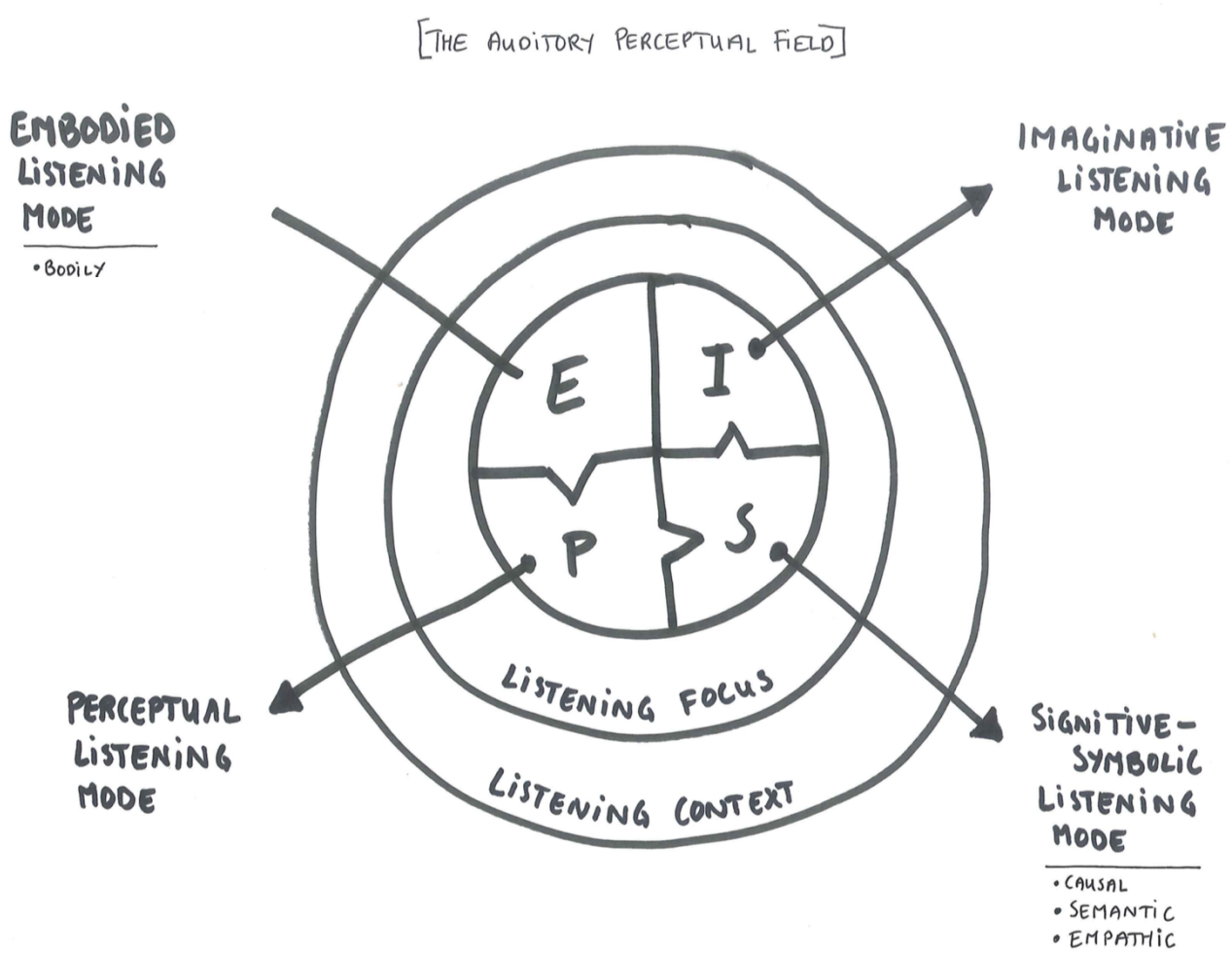

Figure 18: The Experiential framework

The arrowheads in the model illustrate the dependency between the listening modes, where the embodied listening mode is the most primary. The embodied listening mode is fundamental for all the other listening modes since all listening experiences are mediated through this embodied listening mode. In the other end, we find the imaginative listening mode that represents the most abstract listening mode. The imaginative listening mode differs from the other listening modes by not being derived from acoustic actualities but from memories of prior auditory perceptions.

Listening focus describes how we are directed to specific sounds in a soundscape: We can be directed to specific sounds in a more or less attentive manner, and this directedness can be triggered incidentally or chosen selectively.

From a philosophical framework to a design-oriented model

In order to be employed as a practical tool for designers and researchers in a design process, an important step will be to present the experiential framework in a more straightforwardly and explanatory way. This transformation can be done by creating a model that illustrates the framework's experiential themes and their relations in a more colloquial language and with graphical illustrations that are easy to interpret. Based on a phenomenological understanding of auditory experiences introduced in the framework, this model will be descriptive and aimed at assessing auditory user experiential qualities through valuations of the noemata. Hence, the focus in this model will not be on the sound itself, on possible sound effects, or normative instructions and vocabularies. Nor will it be an overview of specific design challenges or recommendations. Instead, it will be a tool that facilitates designers and design researchers of auditory interaction design in understanding the variety of ways users can experience auditory phenomena and the factors that may influence these ways - a knowledge that can be used in evaluations and other auditory design activities. Giving these connections between experience and listening, the goal of the model is to function as a tool for describing, discussing and analysing audio-mediated interaction design from a phenomenological perspective.

Phenomenologically, evaluating auditory experiences is about evaluating the valuing of the generated noemata, and I will look into the pragmatic tradition to see how this valuing process can be further explained and structured.

In the empirical research that was conducted parallel with literature reviews, two senior UX designers from [company in case 1] expressed a need for a tool that did not suggest specific methods or development processes. Moreover, this tool should not create specific ways for the users to articulate their experiences since these types of models are not suitable for the often chaotic, changing and resource-limited everyday life of designers. They have tried to apply such models before with no success.

With the above in mind, I have produced a model (see figure 19) that provides a plainspoken and straightforward overview of the noema-noesis structure of listening and their contextual dependencies on which inquiries into auditory user experiential qualities can be made.

The model is named EPSI, which is an abbreviation of the initial letters taken from the central words of the experiential framework (i.e., ***E***mbodied, ***P***erceptual, ***S***ignitive-symbolic and ***I***maginative).

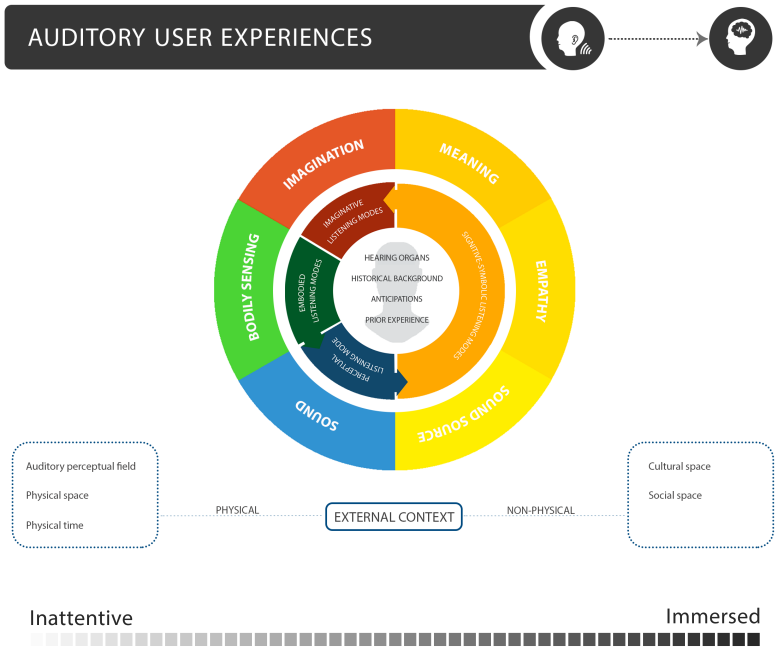

Figure 19: The first version of the EPSI-model.

The outer circle represents classes of noemata (the content of our intentional acts), and the inner circle represents their noetic belongingness. The relation between the noetic listening acts and the noemata is specified through the colours. Thus, the blue perceptual listening mode is directed towards the sound object noemata; the green embodied listening mode is directed towards bodily felt noemata; the yellow-orange signitive-symbolic listening mode is directed towards noemata of sound sources, empathic manifestations, and the meaning behind the sound. The red imaginative listening mode refers to sound object noemata that are not derived from acoustic actualities. The arrows on the inner circle's listening modes indicates their syndetic dependencies: The perceptual listening mode depends on the embodied listening mode, the signitive-semantic listening mode depends on the perceptual listening mode (and therefore also on the embodied listening mode), and

the imaginative listening mode depends on all the other listening modes since they are a product of prior experiences of sounds. A listener will not be able to focus on the signitive-symbolic listening modes without engaging the embodied and perceptual listening mode. However, the engagement of the embodied and the perceptual listening mode might only be on a passive level (i.e., not consciously registered). Likewise, the imaginative listening mode is always engaged in retrospective evaluation sessions since the participants are evaluating on memories of sounds and not on a directly perceived sound.

Issues related to internal contexts such as prior experiences and attitude is placed in the centre of the model, and external contexts are placed outside the circles to signify their autonomous existence. Non-physical contextual themes are placed on the right side and physical contextual themes on the left side.

Before investigating the model on a practical level, a short summary of the different listening modes will be presented.

The embodied listening mode

As we showed in chapter 4 and 5, the embodied listening mode refers to both a bodily engagement in the world, and it is concerned with what we sense with our organs of hearing and nervous system. Thus, in the embodied listening mode, we are directed to the sensorial properties of the perceived sound. This embodied (often incidental) directness to sonic actualities is predominantly intuitive in our everyday life *as passive perception*s. However, it can also be a focused as well as a reflective act like when you feel the sensation of deep bass tone in music or when a high-pitch sound feels unpleasant to the ear.

In the previous chapters, we also concluded that the embodied listening mode is fundamental for all auditory experiences since this mode has to be engaged to take in sounds from the external world - we have to be "touched" by sounds to hear them. Embodied listening concerns thresholds, physiological abilities and somaesthetic, and can be observed through bodily and emotional reflexes.

Regardless of the significant difference in our hearing abilities and embodied listening experiences that are found across different age groups, auditory interfaces that mediate virtual experiences are rarely concerned with the physiological abilities of the users.

Qualities related to embodied listening

The qualities related to this kind of listening can be observed in how we react to sounds, and be described through an evaluation of how a sound is felt. Thus, designing for embodied listening modes requires a focus on the relationship between sounds and bodily actions, as well as the relationship between sounds and emotional reactions. These relationships can be explored through the following design questions:

- *Can the sound be heard*? Knowing the audibility of sounds is an important design aspect because it indicates whether a sound has been taken in or not. The audibility of sounds relates to the thresholds of the hearing subject and can vary a lot between people, as well as between different biological species.
- *How do you sense the sound through your body?* Examples are when music is played so loud that it can be felt in the whole body, which can be valued as either pleasurable or uncomfortable sensation depending on the situation. A sound may also be so loud that the organs of hearing are being damaged. This fact has led to upper-level regulations such as how loud music is allowed to be played in concert halls and how much noise a driving car is allowed to, which has to be consulted within certain design areas. Design inquiries in this area are concerned with whether the sound design triggers the intended bodily reaction and whether this reaction is experienced as pleasurable or not.

Methods such as thresholds measurements to define the listening capabilities of the listener, and observations to see how sound influences the bodily and emotional behaviour of the listener, are possible ways to investigate these design questions.

The perceptual listening mode

The perceptual listening mode refers to a listening mode where the noemata directly refer to the perceived sound, that is, listening through direct perception. In this mode, we are directed to the acoustic properties of the sound that includes loudness, texture, pitch, timbre, structure and rhythm.

We can direct ourselves to sounds in the external surroundings or within ourselves. Sounds perceived from within ourselves are sounds produces by our body, such as tinnitus. Thus, the perceptual field consists of sounds produced internally from our body and externally from the physical sphere surrounding our body.

Internally produced sounds are often only audible to the listener and not to other listeners in the external surroundings.

Qualities related to the perceptual listening mode

In this mode, we are listening to the sound itself, and the experiential valuing in this mode of listening is predominantly expressed through psychoacoustic variables and threshold measurements. The vocabulary to express qualities related to this listening mode varies a lot between specialised groups such as musicians, acousticians, sound designers or other fields working with audio. However, terms such as pitch, timbre and loudness are commonly used between these groups and among non-professionals. Qualities related to the perceptual listening mode can also be found in the masking of certain unwanted sounds and silence.

This listening mode has been given the most attention in research across different scientific fields, from Pierre Schaeffer's focus on sound objects in Musicology, Schafer's focus on soundscapes and sound design's focus on creating the right sounding sound, to audio engineer's research into how to improve the sound quality of loudspeakers, acoustic architectural investigations into sound perceptions in buildings, and audiologist's attempt to make the right adjustment to the acoustic profile of the hearing aids.

As Schaeffer and Chion pointed out (see chapter 5), it is often challenging to focus on the sound itself, since our natural attitude predominantly uses our listening experiences as a tool for navigating and understanding the world and thus focuses on the signitive-symbolic objectivations of sounds. Thus, listening to the sound itself requires training, where both Schaeffer and Chion propose repeated listening as a method to practice this skill.

Since the perceptual listening mode is directed towards the acoustic qualities of the sound, the sound object derived from this sound is the noema of the listening act. Design questions to be explored in this listening mode could be:

- *How does the listener experience and describe the acoustic quality of the sounds*?
- *How can the sound be designed, so it appeals to the listener?*

- *What is the experience of noise and silence?* Noise, as well as silence, can be perceived in many different ways, and the texture and characteristics of noise and silence vary a lot.
- *Why is an acoustic phenomenon perceived as pleasant or unpleasant?* For instance, a sound on a specific volume can be considered as too loud for some listeners, and too low for others.

The signitive-symbolic listening mode

In this listening mode, our noemata are directed to properties of the events or objects signified by the object. I identified three different types of signitive-subjective listening modes. The first is the empathic listening mode, which is a directness towards the emotional aspect of a sound. This directness differs from the emotional directness found under the embodied listening mode in that, empathic directness is a conscious directness, whereas emotional directness is a bodily felt directness. Within the signitive-symbolic listening modes, we also find the causal and semantic listening modes. A causal listening mode is when we direct ourselves to the properties of object or event, causing a sound. The semantic listening mode is a mode of listening where we direct ourselves to the semantic meaning of sounds, which can be both understood as the denotative meaning and the more symbolic meaning of a sound. We direct ourselves to the content of a verbal conversation, trying to decode the functional meaning behind a notification sound, or the symbolic meaning in the sound of a church bell when listening in the semantic listening mode. Listening in this mode requires a high level of cultural knowledge.

Qualities related to signitive-symbolic listening

The qualities found in this category of listening modes relate to how well we can decode the immanent meaning and signifying the value of a sound, and what feelings we have towards the meaning or signified object. For instance, in video games, the voice explaining the instructions of the game can be evident and aesthetically pleasing. However, if we are unable to decode what the voice is trying to tell us, we will rate the experience as unsatisfactory, or if we do understand the instructions but dislike the way the game should be carried out, it would be considered as a bad experience on a semantic level as well. Qualities of the signifying elements of the perceived sound equally apply to the causal, and empathic listening modes: How do we evaluate the sounding object through the sound and the emotional aspect in a song? Thus, research carried out in this listening mode is typically carried out in the fields of cultural studies, anthropology, historiology, social

science and of the domain of the sounding object, sounding subject or sounding event. Bijsterveld and Kreb's historical look into the sound design of automobiles is an example of research into the signitive-symbolic listening mode (Bijsterveld & Krebs, 2013).

Design questions that concern this listening mode include:

- *How well is the content understood?* The abstraction level in the language used in the design should fit the user's domain virtuosity. High-level language for users with little system knowledge and lower level for people with extensive system knowledge. For instance, a person who knows sound design well should be able to manipulate the sound filters on hearing aids to a greater extent than people with no knowledge.
- *Is the emotional design registered as intended and appreciated?*
- *How does culture influence the perceived meaning of the sound?*

A method such as repeated listening seems to have the ability to add more details to the experience of a sound source, the symbolic meaning of a sound and the semantic content of a sound.

Imaginative listening mode

Imaginative listening mode comprises of all listening directed to sound objects derived from imagination. Listening to sounds that are produced by the body, but inaudible to the surroundings are not defined as imaginative listening since these sounds are not a product of imagination. However, inner conversations, the act of going through a song mentally, or imagining the sound of never experienced events or objects (e.g., the sound of aliens). These imagined noemata are directly or indirectly a product of prior experiences of auditory phenomena. This listening mode is the most abstract one since the noemata in this listening act refer to sounds that are not captured in the present physical world and thus not restricted by the physical time and place. Anticipated listening is a type of imaginative listening that is commonly practised. Consistently, throughout the day, we anticipate what to hear. Anticipations can be immediate and pre-reflective like Husserl's protentions that are done at a pace so fast that we do not register the anticipation, and they can be reflective like when anticipating of how the music would be experienced before attending a concert.

Qualities related to imaginative listening

In this mode of listening, the qualities are related to the imagined sound. Is the memory of a song good or bad? Qualities concerning memories can also be expressed in how well the memory is recalled (e.g., how well can we recall a song?).

Valuing of anticipated listening is related to the experiential fulfilment explained in Chapter 4, and can be identified through questions such as *Did we hear what we anticipated? How well did the perceived sound fit the anticipated sound?* Experiential fulfilment is not necessarily considered as a good experience. For instance, if a listener anticipates a bad auditory experience in using hearing aids and this expectation is fulfilled, the experience will be considered as unsatisfactory.

Anticipated listening is predominantly done on a micro-level through protentions, where we are engaged in listening and subconsciously predict what will come next. In sound design, our anticipated listening is often exploited to create illusions such as the phantom words illusion that was first demonstrated by Diana Deutsch[40], a professor in Psychology at the University of California. Repeated sounds coming from two loudspeakers located to the left and the right of the listener, creates the illusion of hearing specific words that are not there but relate to what is on the mind of the listener of the given time[41]. This ability to fill in the blanks through anticipated listening is considered as one of the many reasons why a computer cannot compete with the human brain (Deutsch, 2009).

Listening focus

Listening focus refers to the degree of attention we apply when we listen to sounds within the interval of being inattentive to immersed. In between, we experience different degrees of concentration from passive background intuitions to highly active perceptions. I discovered in the previous chapters that our attention level is constantly changing; one minute we might pay attention to a song on the radio and the next minute we are paying attention to the sound of children playing outside. Only on rare occasions do we pay attention to the same sound for a prolonged period of time. In our natural attitude, our attention continuously moves from one sound phenomenon to another in the soundscape, and from one sense module to another. Thus, a designer should be aware

[40] On her website, Diana Deutsch presents a whole set of musical illusions and paradoxes (https://dianadeutsch.bandcamp.com/album/musical-illusions-and-paradoxes).
[41] http://philomel.com/phantom_words/example_phantom_words.php

that users rarely gives a sound design the same focus as it is experienced in evaluation settings. Auditory experiences are depended on our listening focus since our attention is the driving factor for turning experiences into *an experience*. In this thesis, being attentive is not only a conscious act made by the mind but can just as well be a bodily conscious act since both our mind and body can be attentive to something.

Listening context

Listening context refers to all the external factors that inform the listening experience. These external stimuli have been divided into physical and non-physical contexts. The physical contexts refer to acoustic signals in the auditory perceptual field, auditory mediations (e.g., when a sound is mediated through hearing aids or a loudspeaker), the physical space and the physical time.

As mentioned in chapter 4 objects can be viewed as either an object among other objects (i.e., object as "corpse") or a part of our body (i.e., object as a "lived body"). If an object has become a part of the lived body, the quality of auditory experiences also depends on the quality of the microphone and speaker of the sound mediating device. Thus, a designer should ideally take possible mediating devices into accounts since the acoustic properties and direction of the devices that sound design is mediated through affects the overall auditory experience. For instance, a song may be experienced very differently depending on whether it is played through the loudspeakers of a mobile phone or the loudspeakers in a concert hall. Moreover, questions such as how an audio-based service experienced through hearing aids might be crucial depending on the target group? For instance, voice-based digital assistants might be experienced very differently through hearing aids than without hearing aids.

The non-physical contexts refer to the cultural and social space, as well as the historical and political contexts. These are all factors that create the listening act's variability and thus negate any attempts to describe listening as a unified process. In other words, listening practices are governed by time, place and the background of the listener. Going through all these contextual issues is far beyond the scope of this thesis, but by highlighting these factors, the fluctuating and biased nature of our listening becomes apparent. In my empirical research, I will focus on the noetic-noesis structures of our listening, and the contextual setting and its influence on the listening experience is considered beyond the scope of current thesis.

7. Empirical research

The intent of this empirical investigation is to assess the practical applicability and relevance of my model as a design tool. While previous chapters were devoted to theoretical and philosophical knowledge related to auditory experiences, the current chapter focuses on the practical implications of applying the conceptual knowledge instantiated in the EPSI-model. The past chapters described the theories related to the concept of auditory experiences from a phenomenological-pragmatic perspective, and the empirical research presented in the current chapter shows how the model offers a way to structure and specify qualitative descriptions.
The purpose with the model is to make the designer aware of all the different experiential layers found in the act of listening, from psychoacoustical perception to emotional and symbolic reading, in to visualise this understanding in an easily interpretable way.

Thus, the main objective of this empirical exploration is to evaluate the practical applicability of my theoretical framing in different design activities, and the working hypothesis is that a deeper understanding of human listening structures may facilitate creative thinking, reflective designing, and support the designer in creating more structured descriptions of auditory experiences. Thus, in the following empirical cases, suggestions for how the approach proposed by the model can be applied in different design situations is proposed.

As stated in the previous chapters, the accounts of the listening context and listening focus are just as important as the applied listening mode to a deeper understanding of the characteristics that specify auditory experiences. However, due to limited time resources, the focus in the following empirical investigations is on listening modes since these are directly coupled to intentionality, the fundamental concept of this thesis. Investigating listening focus and listening contexts would require separate investigations due to their multifaceted relation to experiences - a task that has not been possible to fulfil within the timeline of the current project.

In the first empirical exploration, I evaluate the first version of the EPSI-model as an analytic tool on a set of qualitative data describing the experiences of using hearing aids. This evaluation

was the first, and also the most extensive empirical exploration into how the idea of describing listening through listening modes can assist in describing and analysing qualitative data related to auditory experiences.

To explore the EPSI-model's operative value from a professional designer's point of view, I conducted another empirical exploration among professional UX designers and researchers. This exploration consisted of a series of evaluation sessions where I exercised the EPSI-model's practical potentiality. I name these evaluation sessions as the ME sessions[42]. Some of the themes and key statements derived from the dialogues and observations made in the ME sessions, resulted in changes and adjustments to the EPSI-model, while others were kept for future investigations. A review of the EPSI-model was done after each ME session resulting in an EPSI-model that was slightly different from session to session.

However, changes made to the EPSI-model was not just based on results from the ME sessions and the final interview, but also from the literature review that I made alongside these sessions. All these insights transformed the first EPSI-model into the final EPSI-model.

The empirical research and how the results from the research matured the model are explained further in the following sections.

Evaluating auditory experiences

In chapter 3, it was inferred from Wright, Wallace and McCarthy's pragmatic approach to interaction and design thinking that the aesthetics of experiential encounters serves as a basis for describing and assessing user experiential qualities. They created a framework for experience-oriented investigations founded on the pragmatic tradition, where the emphasis is on felt experience that is embedded in the concrete interaction between the subject and the external environment. This framework consisted of four different experiential threads (dimensions): a sensual thread; an emotional thread; a spatio-temporal thread; and a compositional thread. Together these threads formed different types of experiences, from which experiential qualities could be derived.

Additionally, we saw that Husserl's concept of passive and active perception that was presented in chapter 4 could be related to Dewey's definition of *experience* and *an experience* presented in

[42] ME is an abbreviation of Model Evaluation

chapter 3 since they both are based on the human engagement with the world and attribute the level of cognitive engagement to experiential processes. In Husserl's passive perceptions, our engagement with the world was described as being ephemeral and unremarkable, just as Dewey's *experience* that is a non-complete and quickly forgotten encounter with the world. However, Husserl's active perception that was defined as attentive mental acts differs from Dewey's *an experience* that is described as a complete experience, centred around a specific experiential quality (Dewey, 1934, s. 206). Dewey even goes a bit further, by defining aesthetic experiences as a specific emotionally intense version of *an experience*.

Thus, Dewey's "an experience" seems to fit better with Husserl's noema that are sets of perceptions manifested in the conscious mind, that is, conceptualised perceptions.

As with Husserl, Dewey believes that there is a valuation related to every intellectual activity (like listening). Dewey explained the valuation as the felt intensity towards the qualities of an experience and defined it as the aesthetical value of the experience. Evaluating auditory user experiences is, therefore, a matter of identifying the felt qualities in the user's noematic descriptions. When undergoing an experience, an experiential quality has no shape, it only becomes something after the experiential occurrence, when we can start reflecting over the experience (Dewey, 1934).

By combining Husserl's concept of active and passive perceptions with Dewey's concept of everyday experience and aesthetic qualities, we can express experiential qualities through their level of emotional intensity; from the passive indifferent (unemotional) experience to the aesthetical experiences that are intense experiences. In-between, we have the active experiences that do engage the listener, but in ways that are not as intense as with the aesthetical experience. In this way, we can ascribe the experiential intensity-level in a scale-like manner with passive experiences on one side and aesthetical experiences on the other side, as a way of assessing user experiences (see figure 20).

Figure 20: From passive to aesthetic experiences.

Active and aesthetical experiences also differ from passive experiences in the way it can be investigated since active and aesthetical experiences express experiential qualities from a cognitive perspective, whereas passive experiences express experiential qualities from a pre-reflective and bodily perspective. Thus, product evaluations that rely on retrospective reflections on experiences, such as interviews and user reports, will always refer to active or aesthetical experiences, while observational methods are necessary if passive everyday experiences, as found in habits, routines and bodily behaviours, need to be recognised.

For Dewey, aesthetic is not a property of an object itself. Rather it expresses a human reaction to a combination of the object, event, circumstances and the interacting subject. When we find aesthetic pleasure in the encounter, we tend to call it beautiful, but Dewey's concept of aesthetic experience refers to the root meaning of *aesthetic*[43] extended with the sensation of pleasurability. As a consequence, an experience of something horrific or sublime can both be considered as a pleasurable aesthetical experience, as long as they generate intensely pleasurable sensations:

> "The word 'esthetics' refers, as we have already noted, to experience as appreciative, perceiving, and enjoying. It denotes the consumer's rather than the producer's standpoint." (Dewey, 1934, s. 57)

In the above quote, we also see that Dewey defines aesthetic as something positive. Thus, intensely felt negative experiences are not aesthetical experiences, according to Dewey.

[43] Aesthetic is derived from the Greek, *aisthetikos (aisthesis)*, which is a word for perception or to feel, and can be defined as the study of our perception as a whole.

However, experiences that possess aesthetic qualities are not necessarily aesthetic experiences. To become an aesthetic experience, it also has to be *an experience* and not just experience:

> "An object is peculiarly and dominantly esthetic, yielding the enjoyment characteristic of esthetic perception, when the factors that determine anything which can be called *an* experience are lifted high above the threshold of perception and are made manifest for their own sake." (Dewey, 1934, s. 57)

Experiences can, therefore, be described in a matrix-like manner with the felt intensity on one side and its aesthetical qualities on the other side.
In their article "The aesthetical turn: unravelling recent aesthetic approaches to human-computer interaction" from 2005, Lars Erik Udsen and Anker Helm Jørgensen identified four approaches to the concept of aesthetics within digital interaction research: a cultural, functionalistic, Experience-based, and Techno-futurist approach. They argued that aesthetical qualities are best investigated within experienced-based interaction design research, since the functionalistic approach tends to reduce aesthetics to beauty, simplicity and usability, and the cultural and techno-futurists approach is often too difficult to convert into design practices, whereas the experience-based approach offers the most appropriate way to apply aesthetical qualities to digital design (Udsen & Jørgensen, 2005, s. 213).

Empirical exploration no. 1: Auditory user experiences of hearing aid users

In this first empirical exploration, the first version of the model, the EPSI model, is applied as a guiding tool for describing and analysing auditory experiences of hearing aid users. The attempt is not to discover experiential qualities that are universal for all hearing aid users since this approach goes against my pragmatic-phenomenological belief that all design and interaction situations are unique, and therefore have to be treated uniquely. In contrast, the intention is to see how design questions and strategies for these particular hearing aid use cases can be outlined based on the phenomenological approach proposed by the EPIS model.

User reports of hearing aid experiences in the form of video diaries are the empirical material in this exploration. Members of a panel of test users established by [the company] made the video diaries to involve their users in product development processes. These test users are representative to [company name] 's normal target group concerning age, background and character of hearing impairment. The video diaries were made to get some insight into a new hearing aid technology and involve 6 Danish informants (DK1, DK2, DK3, DK4, DK5 and DK6) and 2 American informants (A1 and A2), with a total number of 94 video recordings, altogether. The video diaries are small video clips, between 20 seconds and 3 minutes long, recorded on mobile phones by the test users themselves. In these video clips, they report daily experiences related to their hearing aid use throughout a period of approximately one week. The informants are all adults between 46 and 69 years old and are all a part of a user panel at the [company name], where they participate in evaluations of new products, technologies and concepts. These video diaries were made as a part of an evaluation session of a new hearing aid technology. Some of the participants are familiar with the use of hearing aids, whereas others are first time users.

The physiological shape of the informants' hearing abilities was that all the informants, except one, were experiencing an age-related hearing loss.

The Danish users were free to talk about whatever subject they pleased, whereas the American recorded their answers to predefined open questions. Thus, the Danish video diaries are based on free verbalisation, whereas the American video diaries are based on constrained verbalisation. The data from the Danish hearing aid users were collected in 2017, and the data from the American hearing aid users were collected between 2016 and 2017. I made transcriptions of the video diaries and then the transcriptions underwent a coding process to identify topics related to their experience in general, and listening in particular. Their experience with hearing aid use varied, and so did their expertise in sound and music, ranging from an informant who played in a band and was a headmaster at a music school to informants with no experience within the fields of music or acoustics.

Moreover, six interviews were conducted with audiologists to get some insight into their practical experiences with evaluating hearing aid users’ listening experiences.

Before I present the analysis of the video diaries, some background information about age-related hearing loss (presbycusis) and hearing aids is presented, followed by a brief summary of some of the key findings from the interview sessions.

Age-related hearing loss

Auditory experiences are highly influenced by the skills and capacity of the hearing organs. The measuring factors for the human hearing range are the frequency (pitch) measured in Hertz (Hz) and the loudness (intensity) measured in decibels (dB).

The frequency sensitivity for healthy ears ranges from 20 to 20.000Hz, with the hearing being most sensitive in the 2- 5 kHz frequency range. The loudness sensitivity ranges from the very hard to hear 0 dB to the pain-causing 120 dB (Truax, 2001, s. 16). Typically, sounds with an intensity above 85dB are considered dangerous to the ear. Our loudness sensitivity is continuously shifting, where a sound at a certain intensity might seem loud in some contexts and not in others (e.g., when listening to music at the same intensity at home or a dance hall). As opposed to vision, hearing is omnidirectional, and the location of auditory phenomena is detected based on the delay between the time it takes to reach each ear.

Research shows that nearly half of the world's population over the age of 75 experiences some degree of age-related hearing loss, in which pure tone thresholds are decreasing at high frequency, a deterioration that already starts around the age of 30 (Roth, Hanebuth, & Probst, 2011), and caused by damaged hair cells that cannot be restored. Since age-related hearing loss begins by affecting the upper part of the frequency range, people who have age-related hearing loss often find it problematic to hear birdsong, specific instruments like flutes, and different speech sounds, and to differentiate between different voices with similar pitch. Even among healthy hearing people, older adult's perceptual listening ability concerning human voices is found to be weaker than among young adults (Nambi, Sangamanatha, Vikas, Bhat, & Shama, 2016) (Babkoff & Fostick, 2017). Nevertheless, these age-related issues are seldom a topic among designers of audio-based products outside field of audio-mediating technologies such as hearing aids, headphones and loudspeakers, where amplification is often the only means for controlling the auditory experience. For instance, using birdsong as a part of a mediation app might be a better experience for people under the age of

60, than for those above, and urban-based audio walks might need the possibility of controlling the pitch of the speaker's voice if the target group involves many different age groups.

An audiological test determines the individual hearing ranges with the result mapped onto a graph in an audiogram. Typically, the person undergoes pure tone audiometry, which is a subjective

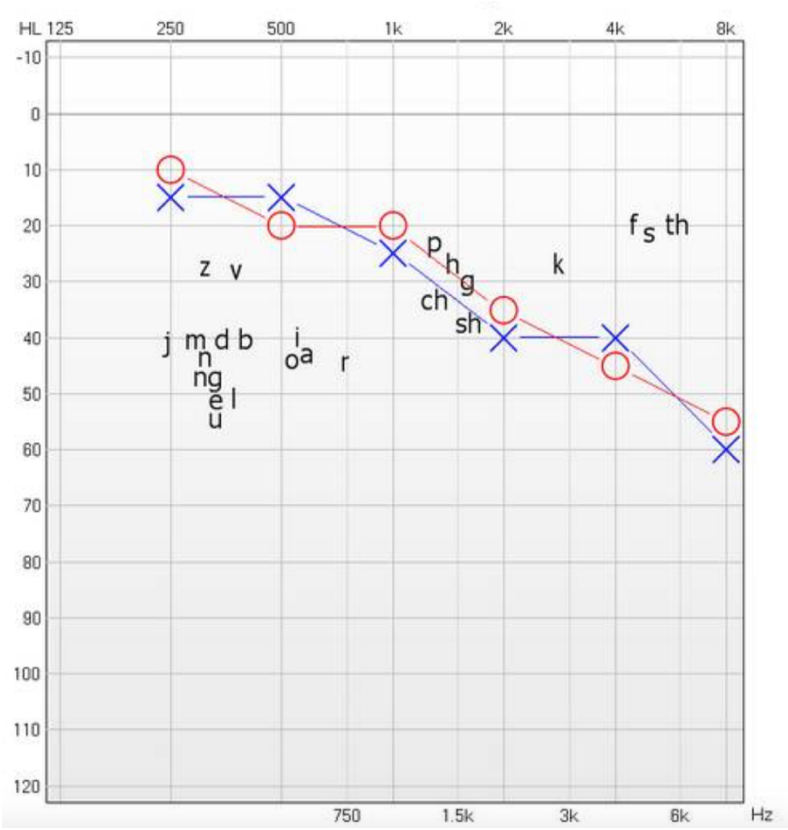

Figure 21: An audiogram of a person with age-related hearing loss (Chime).

hearing test where the test person is presented with a series of beeps and asked to raise a hand or press a button if the beeps are audible. The test illustrates the hearing threshold, and the threshold For both ears is plotted on an audiogram as two separate graphs (Audiology, 2018).

Audiograms are used by hearing care professionals (HCP) as a tool to establish the level of hearing loss, to be used for hearing aid fittings. Figure 21 is an illustration of such an audiogram. The O-graph represents the hearing ability on the right ear, and the X-graph represents the hearing ability on the left ear. The horizontal axis represents the Frequency levels, and intensity levels appear on the vertical axis. The area below the graph indicates audible levels of frequency and intensity, and the area above the graph are the in-audible levels. The picture demonstrates different sound sources and their audibility, and the letters show the audibility of speech. The audiogram in figure 24 exemplifies a typical hearing profile of a person who has age-related hearing loss. As the

audiogram illustrate, some speech sounds are more difficult to perceive than others. Particularly the pronunciation of *f*, *s* and *th* are hard to detect, which makes speech harder to understand because the disappearance of high-pitch consonants turns sentences into mumbling.

High-pitch sound sources such as birdsong and female and children's voices and sounds with a low intensity such as the crackling sound of leaves are also hard to hear when suffering from age-related hearing loss.

Occasionally, an audiologist has to bypass the outer and middle ear to identify physical impairments related to the ear or blockages in the ear; then a bone conduction test is carried out and presented with bracket symbols on an audiogram.

Just as objects can become a part of the lived body (see chapter 4), body parts also have the potential of being experienced as a corpse, if these are malfunctioning or changed. For instance, walking can be a highly reflective act if one has just broken foot, just as driving can be a reflective act if a person is not used to drive. Nevertheless, these malfunctioning and new bodily situations become a part of the lived body over time, which is also the case for people experiencing age-related hearing loss. Fear of stigmatisation is usually the reason why people avoid seeking help from hearing care professionals (HCP) when encountering hearing problems and leads these people to find ways of coping with hearing difficulties in their daily lives (Roth, Hanebuth, & Probst, 2011). Since the age-related hearing loss worsens over time, these people end up contacting the HCP when coping is no longer possible, or when friends or family members no longer have the patience of continuously repeating sentences and of continuously being misunderstood. When these people receive hearing aids, they have often become so accustomed to their hearing loss that they find their new hearing experience too intense, and thus have a hard time using their hearing aids.

Tinnitus

Tinnitus is a physiological condition that cannot be cured and is often accompanied by hearing loss. It is a constant ringing or whistling tone in the ear. Tinnitus consists of illusionary sounds produced by the brain that tries to find a way to compensate from the fewer electrical impulses that reach the cochlea nerve. The sounds caused by Tinnitus can be described as noemata of perceptual listening

since the listening focuses on the properties of specific sounds that are not audible to the external world, but exist within the body.

Hearing aids

Hearing aids are devices that digitally amplify and modify segments of the sound spectrum depending on the hearing impairment profile of the user. Hearing aids can be attached in, as well as behind the ear (see figure 22).

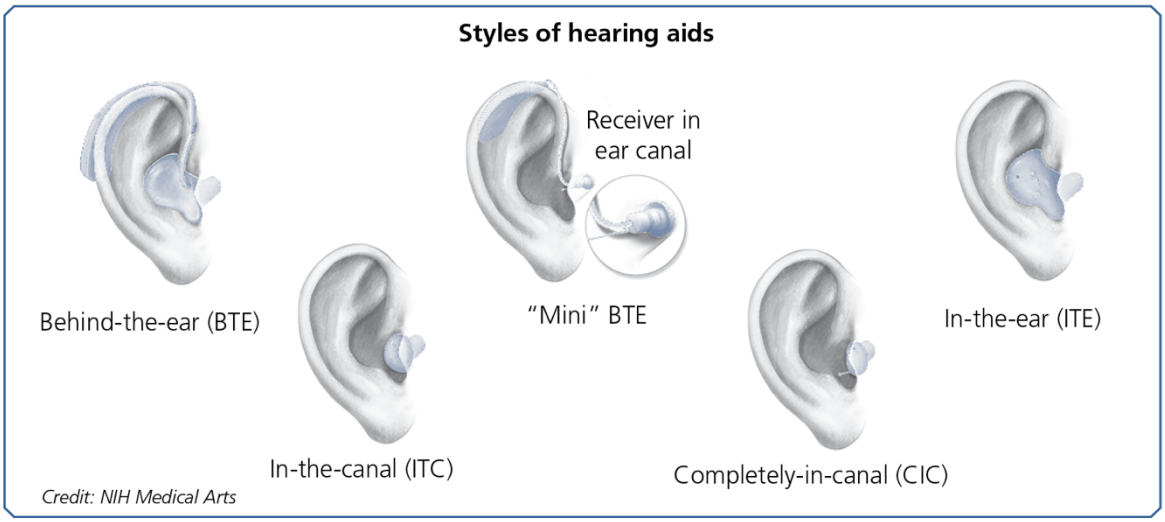

Figure 22: The main types of hearing aids (National Institute on Deafness and Other Communication Disorders, 2016).

Hearing aids are the most common remedy for aiding people who suffer from presbycusis (i.e., age-related hearing loss) and is made up of three components: microphone(s), amplifier and loudspeaker. The microphone(s) detect the sound waves and transform them into electrical signals. The hearing aids then amplifies the electrical signals, as well as fine-tuning the pitch, and then replays the sound through the loudspeakers placed in the ear. Hence, hearing aids represent an interaction form that solely depends on the ear – just as is the case with the radio and telephone and operates in the field of reproduced and manipulated sounds. The mobility of hearing aids makes it more difficult to control the acoustic variables of the incoming sounds since the character of the incoming sounds is continuously changing, due to the constant change in the acoustic environment that surrounds the hearing aid users.

The most advanced hearing aids today come with features similar to headsets such as music streaming and phone calls made through the hearing aids and controlled through the smartphone using a Bluetooth connection. They are also able to change the audio-settings depending on the acoustic profile of the background or through GPS data and have the ability to eliminate wind and background noise.

Using hearing aids requires training, not only to handle the hearing aid device (such as changing batteries, placing them correctly) but also training in the new listening experiences. Even though the hearing aid technology has progressed significantly within the last decade, hearing aids are still not able to mediate a complete reproduction of the auditory perceptual field of normal-hearing people, and they do not have the same ability as the brain to control the auditory focus. Additionally, if the hearing loss has lasted for a long time, the brain also has to retrain its ability of hearing sounds.

Hearing aids can be described as a *mixed reality* (Fuhrt, 2011, s. 3) design since they make use of both a computer-manipulation and diminishing reality[44]. Hearing aids users may experience that their whole listening is based on reproduced sounds as in closed-fitted hearing aids (the hearing aids mediate all external sounds) or, only partly reproduced, as in the open-fitted hearing aids (sounds are both directly perceived and mediated through the hearing aids) (Winkler, Latzel, & Holube, 2016). However, both types can be categorised as mixed reality as all the sounds, reproduced or not, have the external acoustic environment as a source.

Hearing aid users are supposed to wear their hearing aids in all waking hours. Hence, it is not possible to evaluate the full experience of hearing aid use. An evaluation has to be broken down to small experiential fixpoints. In the Danish video diary recordings that relied on free verbalisation, the fixpoints are the experiences (good as well as bad) that were intense enough to be remembered, which in Dewey's terminology would be characterised as a*n experiences*, while the American video diary recordings' pre-defined questions acted as the experiential fix points.

Interviews with audiologists: A holistic approach to listening experiences is needed

The audiologists I interviewed in the case study expressed a need to take in other dimensions than psychoacoustic measurements, but currently only have tools to evaluate listening experiences

[44] where sound signals can be decreased or diminished

through psychoacoustic dimensions and thresholds. The available evaluation tools are audiograms (i.e., an overview of a patient's frequency thresholds measured with an audiometer) and a limited psychoacoustic vocabulary consisting of loudness, treble, pitch and timbre (i.e., the words understood by the patients). Thus, the focus in the audiological listening tests is on finding errors and faults on the perceptual level. The audiologist Au2 gave another reason for the audiologists' focus on psychoacoustic qualities:

> "Without the ability to hear the different sounds well and the ability to tell them apart, nothing else makes sense in the listening experience." *– from the interview with the audiologist, Aud2.*

This statement supports the phenomenological claim that all experiences are mediated through the body and thus dependent on the embodied (perceptual) listening mode.

However, all except one audiologist expressed a need for a tool that takes in other variables than psychoacoustic constants. One of the audiologists, Au6, expressed this need through an anecdote from his workplace, where he experienced that two patients with the same audiogram and the same demographic and social background, reacted very differently to the same auditory experience. He further explained that using an audiogram to describe auditory experiences is like using a map to describe how life is in Denmark.

Video diaries: The analysis process

After having collected a large number of video diaries, I began the long process of transcribing, selecting and systemising the empirical material. My journey into describing the auditory experiences of the hearing aid users commenced with a separation of all experiences uttered in the video diaries into three overall groups: 1) experiences relating to wearing and operating the device, 2) experiences related to the social and physical environment of wearing hearing aids, and 3) experiences related to listening (see figure 23).

Figure 23: The first categorisation made from the video diary data

After this crude classification, I selected all experiences related to the act of listening for further investigation.

Once the experiences related to the auditory experiences were selected, the noeses-noemata structures were examined to identify listening modes, qualities and the valuation of these qualities. The overall result from the analysis can be found in table 1-5, and the results from each participant are placed in Appendix 1-8.

This analysis serves the purpose of illustrating how the EPIS model can be used as a tool for evaluating qualitative data of auditory user experiences.

Using NVivo for data analysis

Considering the vast amount of qualitative data in this project, I anticipated that NVivo[45]software might become a valuable analytic tool in handling the data. By transcribing directly into Nvivo, I became familiar with the software. Nvivo gave me the advantage of allowing me to code while transcribing if interesting themes and statements emerged under the transcription process. Nearly one-hundred video sources have been transcribed in detail, resulting in several pages to be analysed.

Even though transcribing the video material was a laborious task, I found that this process had the advantage that I developed a close relationship to the data. The video diaries were recorded in a static interview style.

Common working protocol applied in the transcriptions

I provided all the text passages in the video transcriptions with timestamps to easily identify them in the video recordings. Words preceded by punctuated dots in square brackets […] indicates a break in the conversational flow. Words framed by square brackets indicate behavioural actions such as laughing and moving around, whereas words in round brackets indicate my thoughts or comments.

The hearing aid users are identified through their nationality, followed by a unique number, to preserve their anonymity.

The steps in the analysis process

As I have argued throughout this thesis, central to describing and analysing auditory user experiences is the noema-noesis structures identified through first-person experiential descriptions of the lived life. Experiences can then be described and analysed in terms of the felt intensity towards the qualities found in the personal narratives.

The video diaries are narratives of hearing aid users' experiences with a new product launched by [the company]. The hearing aid users have tested this new product and were told to document their experiences through video recordings on their mobile phone.

The overall purpose of this analysis process is to give the reader an example of how the EPSI model can be applied as an analytic tool to produce comprehensive and holistic auditory experiential descriptions of qualitative data. However, due to limited time resources, it was not

[45] NVivo Qualitative Analysis Software is a relational database program developed by QSR International.

possible to review the analysis more than once. Through questions such as "*How do the hearing aid user's experiential descriptions relate the proposed listening structures?"* and "*What is the content and quality of their experiences?*" the EPIS model is used as a way of structuring and gaining a more in-depth insight into *what users are talking about when they talk about auditory experience*.

The idea behind the practical use of the EPIS model is as much about offering a way to describe auditory experiences as it is about structuring auditory experiences.

In the following sections, I present a more detailed description of the analysis process.

The first step

The first step in the analytical process was to separate the experiential declarations that concerned auditory experiences from other experiential declarations. A *line-by-line* coding method (Charmaz, 2006) was employed in this initial coding of the data to identify concerns related to listening experiences. This process reduced the amount of data a great deal since the predominant focus in the reports were towards the comfortability of wearing and handling the hearing aids; from battery change and Bluetooth pairing to how they can be placed comfortably in the ear and how to avoid losing them.

The second step

After the initial identification of auditory experiences, a process of associating these experiences with the noetic listening acts of the EPIS model began, as well as writing down the noemata belonging to these noetic acts and the valuation of the noemata. Thus, the noemata are the subject matters to which auditory user experiential quality assessments are made. The result of this second step is illustrated in table 1.

Table 1: The result of the second step.

	Embodied	Perceptual	Signitive-symbolic	imaginative
A1	**Ability to hear** Ears clogged with wax makes it difficult to hear. **Damaging loud sounds**. The hearing aids help to protect the ears from loud sounds. When a sound too loud	**Own voice** sounds different. **Own voice** sounds distorted. **Signal-to-noise (foreground vs background):** when turning up the volume	**Follow a conversation** when talking to other people in noisy places (semantic). **TV-listening**. TV-listening is improved (semantic).	**Anticipates that he will have the ability to follow conversations** with hearing aids.

	occurs, the hearing aids will turn off. **Ability to hear**. Some sounds come better through than others. **Object-as-the-lived body**. In quiet places, it is difficult to register whether the hearing aids are in or out: Do I hear or not?	to hear better, all sounds in a room is amplified, so it doesn't help. **Inner sounds** such as chewing crunchy food, are perceived as very loud with the closed fitted hearing aids. **Tinnitus sounds**. The quality and impact of tinnitus influence the experience. **Background sounds**. The ability to hear in noisy places is better. **Background sounds**. Some consistent background sounds obstruct the listening experience much more than others.	**Discriminate between different voices.** The ability to discriminate between different voices in noisy places (causal). **Placement of sound sources**. Some sound sources are difficult to hear (causal). **Voices in a crowd**. The ability to pick up voices from a crowd is better (causal). **Sound of nature and traffic**. The quality of the sounds of traffic and nature is much better (causal).	
A2	**Emotional feeling of regain the ability to hear** previously unheard sounds. **The ability to hear** in noisy environments. **Object-as-the-lived-body**. Wears the hearing aid as often as possible to make them "invisible". **Hearing previously unheard sound sources**. The experience of the sound of birds and leaves crackling. Sounds that could not be heard before.	**Background sounds**. The effect of background sound on listening. **Feedback sounds** from hearing aid. The sounds made by the hearing aid. The **sound of Nature** is pleasing. **The sound of the wind.** The effect wind sounds have on hearing aids.	**TV-listening**. Easier to hear what is going on on TV. (causal) **Talking on the phone.** Can follow conversations on the phone. **Whistling sound of the wind**. Spoils the listening experience (causal).	**Anticipates a lot of noise** in restaurant and grocery stores.
DK1	**Regain Hearing**. Hearing events in the surrounding.		**Follow conversations.** Hear what people are talking about.	
DK2	**Mental exhaustion**. It takes a lot of mental efforts to listen to all the new sounds.	**Listening to music.** The experience of music listening.		**Anticipates low sound quality** in hearing aids.

	Some **sound sources are being shut out**, which obstructs the listening experience. **The ability to hear**. Some sound sources are being shut out, which obstructs the listening experience.	**Tinnitus sounds**. The effect tinnitus has on auditory experiences. The **sounds mediated through** the hearing aids are somehow distorted.		
DK3	The **ability to hear previously unheard** sounds.	**Background sounds**. Noisy backgrounds (hi-fi or low-fi = quality). Natural sounding **sound sources**. (natural or distorted = quality) **The treble**. The perceived treble. **TV-listening.** The quality of TV listening.		**Anticipates low sound quality** in hearing aids.
DK4		The **quality of streaming sounds**. The **quality of the sounds mediated** through the hearing aids.		Compares the sound quality in the hearing aid with his **memories of sounds.**
DK5	The ability to **hear previously unheard sounds**.	**Background sounds**. Noisy background.		**Anticipates lots of background noise** in grocery stores.
DK6	The reaction to the **notification sound** on the hearing aids. Some **sounds are hard for the ears** – not because they are too loud, but because the sound is stressful.	**Background sounds**. Noisy background. **The treble**. The perception of the treble. **Background noise**. The filtering of background noise. The sound of **own voice**.		

The auditory experiential descriptions are written with minimal valuation to preserve the confidentiality of the hearing aid's qualities. The noemata found in the experiential descriptions are highlighted in bold letters.

Third step

In this third and final step, I clustered the findings from step two into the classes of noemata suggested by the EPSI-model. After a classification of the auditory experiences, the experiential content was analysed based on their felt intensity and aesthetical value. The results from the quality assessment have been left out in the thesis due to confidentiality. However, the experiential description of each participant can be found in Appendix 1-8.

Results from the first empirical exploration

I found a significant difference in the content of the Danish users who could freely express what they had in mind and the American users who were prompted for answers. The Danish video diary informants only made few (between 1 and 8 video clip per user) and small contributions, whereas the American video diary informants made many and very extensive reports (between 30 and 40 video clips per user). This difference might be explained by the imperfective interaction mode of hearing aids, where an experience with the hearing aids among the Danish users only is made if a breakdown or something extraordinary good occurs. The American informants, however, were given specific tasks and questions that made their perceptions active towards specific listening situations. The Danish audiologists preferred video recordings where the users were free to talk as they pleased, whereas the American UX team wanted the users to focus on specific user experiences.

Table 2-5 presents the results from step 3. The left column displays the identified main themes, the middle column displays subcategories, and the right column displays possible design and research questions to be applied in future investigations.

Table 2: Quality themes identified in the embodied listening mode and possible evaluation and research questions.

Embodied listening mode		
Main themes	**Subthemes**	**Possible design and research questions for auditory experiential quality assessment?**
Physiological hearing ability	Hearing recovery	How does it feel to regain hearing?
		What (type of) sounds do you find difficult to hear, and how does it affect your listening experience?

	Mental efforts	How exhaustive do you find your new listening experiences?
	Notification sounds	Are the notification sounds (e.g., battery status sounds) registered, and do they afford the intended reaction?
Hearing device as part of the body		To what extent do you consider your hearing device as being a part of you?

Table 3: Quality themes identified in the perceptual listening mode and possible evaluation and research questions.

Perceptual listening mode		
Main themes	**Subthemes**	**Possible design and research questions for auditory experiential quality assessment?**
Inner sounds	Own voice	How do you find your own voice? (too loud? too distorted?)
		In what way do your voice sound different?
	Chewing	Does chewing food affect your experiences, and in what way?
	Tinnitus	How would you describe your tinnitus sound?
		How do you cope with tinnitus sounds?
Soundscape	Hi-fi vs low-fi environments	How well do you hear in hi-fi environments?
		What do you characterise as hi-fi and low-fi environments?
	Acoustic territories	What acoustic environments do you find stressful?
		Do you avoid specific places because of background noise?
Mediating sound quality	Streaming	How do you find the sound quality when streaming sounds (e.g., TV, phone calls, etc.)?
	Hearing aids	How do you find the sound quality of the hearing aids? (e.g., treble, distortion, etc.)
		How would you define good sound quality in hearing aids?
Music listening		How would you describe the quality of your music listening?

Sounds structure	Pleasant/unpleasant	What sounds do find pleasant/unpleasant? Why?
	Stressful sounds	What sounds do you find stressful? What acoustic properties make a sound stressful?
	Loudness	In what situations do you perceive sounds as loud?
		What sounds do you find too loud?

Table 4: Quality themes identified in the symbolic-signitive listening mode and possible evaluation and research questions.

Symbolic-signitive listening mode		
Main themes	**Subthemes**	**Possible design and research questions for auditory experiential quality assessment?**
Sound source	spatiality	How well do you register the location of sound sources?
	Human voices	How would you rate your ability to discriminate between different voices?
	Feedback	Do you experience any feedback from the hearing aids? If yes, how does it affect your listening experience?
	Wind	How does the wind affect your listening experience?
	Environment	What Nature sounds are you able to hear?
	Environment	How does background sounds affect your listening experiences?
Semantic listening	Following conversations	Are you able to follow conversations?
		Can you follow conversations on TV?
		Are there any situations where it is difficult for you to follow conversations?
		How does it affect you, when not being able to follow conversations?

Table 5: Quality themes identified in the imaginative listening mode and possible evaluation and research questions.

Imaginative listening mode		
Main themes	**Subthemes**	**Possible design and research questions for auditory experiential quality assessment?**

Anticipation	conversations	How do you anticipate your ability to follow conversations with the hearing aids on?
	locations	Do you anticipate specific auditory experiences in specific locations? For instance, in grocery stores, restaurants, etc.
		How does your anticipation of specific locations affect your behaviour?
	Hearing aids	How does your auditory experiences with hearing aids match your anticipated experiences?
Memories		What sounds that you hear with your hearing aids on do not match your memory of the sounds?
		Are there any sounds you miss to hear?

The auditory experiential quality assessment was based on the emotionally felt intensity towards the identified themes and their aesthetical value. The aesthetical value was identified based on whether these emotions were considered positive or negative, pleasant or unpleasant, satisfying or not satisfying.

Positive experiences were rated with a (+), and negative experiences with a (-). The felt intensity of the experience was rated on a scale from 1 to 3, where 1 refers to little emotionally felt experience and 3 was given high emotionally felt experiences. Thus, very positive experiences were rated with three plusses (i.e., +++) and very terrible experiences were rated with three minuses (i.e., ---). Neutral experiences were given a (-+). I have omitted the ratings in the tables, because of confidentiality. The following section summarises the overall result of the felt auditory experiential quality assessment without exposing the experiential quality of [the company's] product or technology.

Design reflections made from the analysis

The following reflections are only made to set an example of how design reflections can be derived from the identified noematic descriptions. A specification and discussion of the findings from this empirical exploration are made in the next chapter.

- *Help the users to change their focus from perceptual listening to embodied or signitive-symbolic listening.* Positive listening experiences were predominantly found within the

embodied and signitive-symbolic listening mode, while a focus on the perceptual listening mode often provides negatively felt experiences since sounds mediated through hearing aids cannot compete with the quality of non-mediated sounds. Train the users in focusing on embodied and signitive-symbolic listening modes instead of the perceptual listening mode (e.g., the sound quality) might create a more positive listening experience, and make it less likely for the user to give up on the hearing aids. This help in changing the listening mode could be practised through small exercises where the user is asked to write down previously unheard sound sources down (e.g., all Nature sounds) or to make notes every time there were no problems in following conversations.

- *Improvements of the sound quality*. Improving the sound quality, algorithms and the technology of the hearing aids have the highest focus within the hearing aid industry. However, with today's technology, it would not be possible to compete with the sound quality experienced by healthy hearing people. However, offering the user an interface that allows a more detailed fine-tuning could facilitate the users with a profound focus on the perceptual listening mode.
- *Acoustic territories*. Make more comprehensive descriptions of acoustic territories to identify what makes them appear noisy and chaotic and to create more fine-tuned soundscape classifications in future designs when programming hearing profiles on hearing aid devices, or design interfaces that allow the user a more detailed fine-tuning. Today, a standard categorisation of acoustic territories in hearing aids are restaurant mode, outdoor mode and traffic mode.
- *Internal sounds*. Tinnitus programs on hearing aids are made to mask the sounds produced by tinnitus. However, bodily sounds such as chewing and the feedback sounds from the hearing aids can be very disruptive for the hearing aid user, too. Would it be possible to create an acoustic profile for eating that somehow masks or filters out some of the disruptive bodily sounds when eating?
- *Anticipations*. Knowledge related to previous experiences of using hearing aids should always be addressed since these previous experiences shape the anticipations and thus, the attitude towards hearing aid use.

- *Primary vs secondary listening modes*. When making inquiries into the more secondary listening modes, the primary listening modes should always be addressed. For instance, if a designer wants to focus on the causal listening mode in his or her design, he or she should always include reflections on the quality of the perceptual and embodied listening mode, as well.

Empirical exploration no. 2: Assessment sessions with UX designers and researchers

The assessment of the EPSI-model made in this second empirical exploration was carried out among professional UX designers and researchers. The assessment sessions (denoted ME sessions) involved two small exercises that roughly mimics two separate activities in a design process combined with an open-ended dialogue of the relevance of the EPSI-model as well as its value as a design tool. The first exercise in the ME session utilises the EPSI-model as a tool to guide a design evaluation. In the second exercise, the participants were instructed to apply the model as a tool for exploring the potential of auditory communication through a small creative activity.

No formal questions were prepared, as the intention was to let the participants and the results from the exercises lead the dialogue. Alongside exploring the workability of the model, the exercises also provided some consistency between the different ME sessions.

All the ME sessions, except one that took place at the IT University of Copenhagen, took place at the workplace of the participants, and a tape recorder was used to capture the dialogues made in the sessions.

A workshop that had all the participants together would have been preferred. However, arranging a meeting with senior UX designers and researchers from reputable busy companies with some of them being located more than 250 kilometres away (Struer, Denmark), didn't allow for such an arrangement in the given time frame. Thus, I ended up arranging separate meetings with the individual designers and researchers and planned small hands-on exercises that could fit into their busy work schedules.

After each ME session, I adjusted the EPSI-model according to the results from the ME session and literature reviews made in between the sessions. The different versions of the EPSI-model are presented in the end of this chapter, and the final version is illustrated in chapter 8.

The participants

I ran four ME sessions with one participant in three of the sessions and two participants in the fourth. Two of the participants were females, and three of the participants were males. Two of the participants work at Bang & Olufsen A/S where one has the position of a senior UX designer, Usability Lead, and Product Owner, and the other is a UX researcher. Another two participants work at Brüel & Kjær Sound & Vibration Measurement A/S as an Innovation Manager and Research Engineer, respectively, and the last participant work as a senior UX designer at Moodagent A/S.

Bang & Olufsen A/S[46] is a well-known Danish manufacturing and design company dating back to 1925. They are specialised in luxury-end televisions and audio products. Brüel & Kjær Sound & Vibration Measurement A/S[47] is a Danish company founded in 1942 and is the world's leading supplier of sound and vibration quality measurement equipment and systems. Moodagent A/S[48] is a Danish company established in 2010 offering a user-centric music streaming service that not only allows music characterisation through properties such as genre, vocal style and instruments but also on moods and situations.

In order not to link the comments directly to the participants, I refer to the participants as P1, P2, P3, P4a and P4b. The number following the letter P refers to the time sequence of the participants participation in the ME-session. P4a and P4b participated together in the same ME-session.

As mentioned in the design research chapter, the model underwent continuous adjustments according to the literature review made parallel to the empirical research, as well as according to results from each empirical investigation. Thus, different versions of the EPSI-model were presented to the participants in the ME-session: P1 evaluated the 1st version of the EPSI-model, P2

[46] https://www.bang-olufsen.com/en
[47] https://www.bksv.com/en
[48] https://moodagent.com

evaluated on the 2nd version of the EPSI-model, and P3, P4a and P4b evaluated on the 3rd version of the EPSI-model.

First exercise in the ME session: The EPSI-model as an evaluation tool

To make sure the participants were not influenced by my approach when making their first evaluation, the EPSI-model was introduced subsequently to the first evaluation. In the first evaluation, the participants were asked to write down their auditory experiences and the felt intensity of these experiences on post-it notes. After this first evaluation, I presented the EPSI-model for the participants. The participants were then asked to place the post-it notes from the first evaluation on the dimensions of the EPSI-model, while we were conversing about the model's approach and structure. Figure 24 illustrates the placing of the post-it notes on an outline of the EPSI-model from one of the sessions.

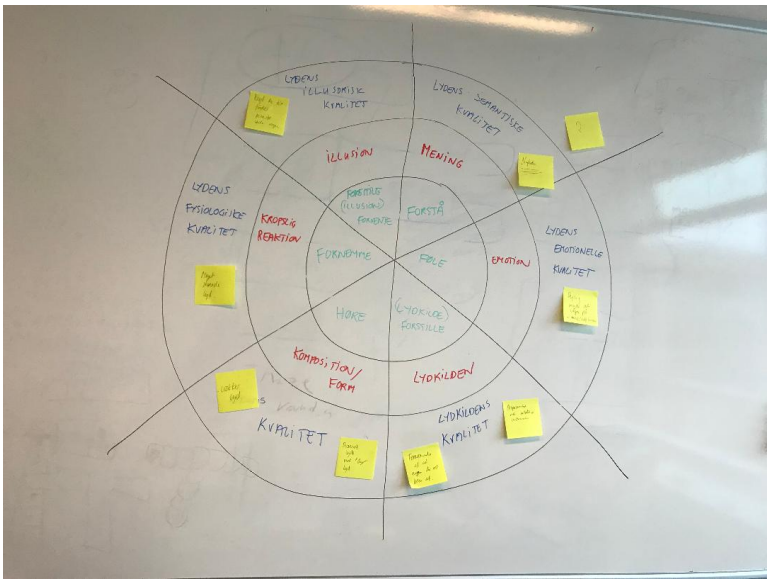

Figure 24: The post-it notes placed on the relevant dimensions of the EPSI-model.

In the first ME session I ran, the participant was asked to re-evaluate the sound piece after the EPSI-model has been introduced, while I let the participants listen to the sound piece again before re-evaluating the piece with the EPSI-model as a guide. After reviewing the first three ME sessions, I decided to let the participants write down their auditory experiences in the relevant fields of a scheme that was handed out before the second. The scheme is a table where the rows represent the listening dimensions of the EPSI-model, and in the columns, the participants can describe and rate the felt quality and aesthetical value of the experiences in a simplistic manner using a scale from +++ (intense positive experiences) to --- (intense negative experiences). Thus, noetic-noemata relation and the appreciation of the noemata produced by the sound design was the centre of attention in this scheme. Figure 25 illustrates one of the filled-out schemes.

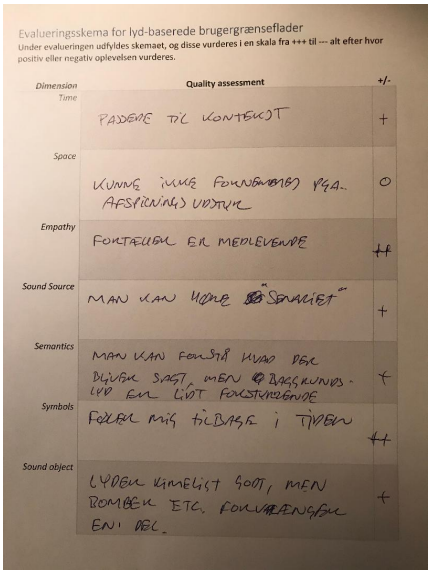

Figure 25: The scheme handed out in the two last sessions.

Table 6: The procedure of the first exercise.

Step	Content of the steps
1	The participant listens to a specific piece of sound design.
2	The participant is asked to describe and evaluate the sound piece using their experience as an auditory UX designer/researcher, and write their evaluation statements down on post-it notes.
3	The EPSI-model is introduced, and the participant is asked to place the post-it notes on the relevant dimensions of the presented EPSI-model. While placing the post-it notes, the EPSI-model is being discussed.
4	The participant is asked to listen to the same piece of sound design again, and subsequently write down their experiences and felt quality of the experiences on a scheme.
5	The results from the two auditory experiential evaluations are compared through a dialogue of how the EPSI-model affected their description and evaluation of listening experiences, and whether the EPSI-model helped to identify new experiential aspects in the evaluated sound piece.
6	The overall experience of using the EPSI-model as a guide for evaluating auditory user experiences is discussed. During this dialogue, I note all significant statements made by the participant that referred to an assessment of the model as a practical design tool.

While doing the exercise, differences between the two evaluations were detected, and the value of the EPSI-model was discussed.

In my analysis, I do acknowledge that listening to the same piece over again may create a different, and possibly, more focused listening. From my phenomenological perspective, the assumption is that it is not possible to listen to the same sound piece over again and having the exact same experience of that sound, as well as successive listening, may automatically create more intense and refined listening experiences. However, letting the participants of the last three ME-sessions listen to the same sound piece in the second evaluation round was regarded as necessary to help the participants remember the content in the sound clip. Since the focus is on creating conversations about the practical value of the EPSI-model rather than the sound clip itself, I found this procedure more suitable for the purpose. Even though the participants act as users in this exercise, it is important to emphasise that the objective was not to accomplish a thorough evaluation of the chosen sound piece, but solely to demonstrate how the EPSI-model can be applied practically in an evaluation situation.

In this exercise, *free verbalisation* was used as a method to describe the presented sound piece. The idea of the EPSI-model is not to restrict a free verbalisation, but to be a supportive tool for expressing experiences. With no restrictions imposed and without any guide, the participants revealed the listening mode(s) in focus in the first evaluation round in the exercise, and thus acted as real users with no prior knowledge of possible listening modes[49].

Sound pieces used in the first exercise

The sound pieces presented to the participants were selected for their length and their high complexity level, that is, a sound piece with many different sound elements that allow the participants to apply different listening modes. According to the length, the sound clips needed to be short enough to be recalled in working memory after end listening. P1 was presented with a sound clip with a length of approximately 5 minutes and 30 seconds from the sound-based game Blindscape. P2, P3, P4 and P5 was presented with a (roughly) 3 minutes and 30 seconds long sound clip from the audio-walk application “1807”.

[49] The EPSI-model is a tool for designers, not the users. Thus, in evaluation situations, the users are meant to talk freely in their natural attitude, where the designer can use the EPSI-model to direct the conversations and to structure the qualitative data from free verbalisations.

In the following sections, I provide a short description of the chosen sound designs.

The Awe: 1807

"1807" is a mobile-based audio walk application for iOX and Android platforms made by the start-up company, The Awe[50]. The historical event that took place in Copenhagen in 1807 is presented through a location-based augmented reality (AR) audio-service that combines a storytelling voice with a dynamic 3D background soundscape design that emphasises the event. The storyteller informs listeners about the British bombing of *Church of Our Lady* in Copenhagen that occurred in 1807. A soundscape design of bombs and people screaming in panic is heard in the background, together with the collapse of the church's tower.

The idea is that people visiting the church have the possibility of being taken back in time, auditorily, and become familiar with the story behind the fall of the church's spire in 1807. It is only possible to download the sound content while being at the location. The dynamic 3D sound design is a location-based service and takes place right at the Church of Our Lady's real geographical location with a sound effect that allows the listener to walk to and away from the incident. However, it is possible to save the content and play at any location afterwards. The application target tourists and people, school children and people with a historical interest in Copenhagen. I have downloaded the sound content and saved it for the purpose of evaluating the EPSI-model.

Figure 26: Church of Our Lady, Copenhagen

Blindscape

Blindscape[51] is an audio-only storytelling mobile game for iOX and Android platforms designed by Gavin Brown. This short explorative game takes place in a post-apocalyptic authoritarian world, and the story is told through a blind male protagonist who seeks a way to escape the world. The sound is designed dynamically with 3D effects and is a blend of sounding objects and events, the

[50] https://theawe.dk/portfolio/1807/
[51] http://www.blindscapegame.com

Figure 27: A screen dump from Blindscape.

narrator's voice and music, and the graphical interface is just a black screen with a little hint link in the left bottom of the screen (see figure 27).

The second exercise

When time allowed, I introduced the second exercise to the participant.

The second exercise is built on the idea of the phenomenological concept of variation. That is, the participant has to create different sound designs for an alarm clock that apply different listening perspectives according to the listening modes of the EPSI-model. In this exercise, the participants create a design that intentionally shapes the noetic listening structure with the alarm clock signal as the noema. In this simple ideation activity, the participant is instructed to use the model as a tool to encourage out-of-the-box thinking and to explore the different communicative possibilities of sound design.

The intention behind this noetic shaping in which the participant suggests different designs that afford different listening modes was to stimulate a discussion of how the EPSI-model can guide concept developments and ideation processes as well as to investigate how the participants understood the different listening modes of the EPSI-model.

Results from the exercise

Participant P1, P3 and P4b completed exercise 1, and only P1 and P3 completed exercise 2. P2 did not complete exercise 1 due to technical problems with the playback of the sound clip. P2, P4a and P4b did not complete exercise 2 due to insufficient time.

Table 7 presents an overview of the findings from the ME-sessions. The identified themes are written in the right column. The participant who raised the theme is marked with a (*) in the middle columns. Comments are written in the left column.

Table 7: An overview of the themes raised by the participants.

Themes	P1	P2	P3	P4a	P4b	Comments
Themes related to the use of the EPSI-model						
More extensive auditory experiential descriptions after being presented with the EPSI-model.		-	*	-	*	P2 and P4a didn't complete the evaluation exercise. P3 found more than twice as many experiential topics with the use of the model, and P4b mentioned two more topics in the evaluation.
More detailed auditory experiential descriptions after being presented with the EPSI-model.	*	-	*	-	*	P2 and P4a didn't complete the evaluation exercise. P1, P3 and P4b described their auditory experiences in greater details with after being presented with the listening modes of the EPSI-model.
The EPSI-model can be used to create listening profiles among users.			*			When evaluating sound design, listening profiles can be created based on how the different users attend to the sound design.
The EPSI-model as a communication tool that focuses on design activities related to ideation, evaluation, analysis, and strategy planning.	*		*		*	P3 described the EPSI-model as a communication tool that gives sound designers an overview of the different ways in which users may communicate their auditory experiences. This overview can be useful when planning evaluations and to structure users' experiential descriptions. P4b likewise finds the model useful in giving the designer an overview of the possible directions in which sounds can be communicated.
The EPSI-model as a categorising tool			*	*	*	P4a describes the EPSI-model as a sound perception model that categorises the different ways sounds can be perceived. P3 and P4b found the EPSI-model useful as both an explorative and analytic tool for categorizing user's auditory experiences, terms and concepts into smaller and more manageable parts. P3 and P4a would like to have relevant vocabularies and design methods included in the different dimensions of the model.

The EPSI-model as a tool for presenting the communicative capabilities of sound.	*		*			Both P1 and P3 saw the EPSI-model's overview of how people can attend to sounds, as tool that facilitates creative thinking and enhances an experiential understanding.
Taking a starting point in the user's natural attitude towards auditory experiences.			*			P3 appreciated the idea of having a tool that takes is starting point in the natural attitude of the users.
Themes related to the design of the EPSI-model						
Difficult to categorise some of the more complex sounds into a specific dimension.			*			P3 found it hard to categorise some of the complex sounds into any categories. However, P3 did appreciate the way the EPSI-model separates different ways of listening even though some experiences are hard to categorise into separate listening modes.
The dominant position of the Sound Object listening has to be emphasised in the model.		*	*			P2 emphasised that the fundamental position of the sound object listening has to be clear in the EPSI-model. This comment led to changes in the design of the EPSI-model. Being presented with a newer version (the 3rd version) of the EPSI-model, P3 appreciated the way in which the model illustrates the fundamental position of the sound object listening mode.
The different listening dimensions should be more clearly defined.		*		*	*	P2 found many of the listening dimensions difficult to understand and requests a more precise definition of these. Particularly the concept of time, space and society. P4a wanted to change the word semantic since the meaning of semantic within the audio industry refers to sound quality perception. P4b suggested to and some textual or visual guidance to help understand and remember the meaning of the different modes.
The colours of the listening modes should represent their belongingness.		*				The relation between the listening modes should be suggested more clearly through the colours. Only related listening modes should have related colours.
Internal and external context	*	*	*	*	*	The internal and external contexts should be more prominent in the design since these are essential to how we experience sounds.
Difficult to fit some of the listening experiences into one listening mode.			*			P3 found it difficult to make some of the listening experiences fit into one listening mode, and observed that sound object listening was present in nearly all the listening experiences. However, P3 saw that one

						listening mode was more in focus that others if more than one listening is present.
Emotional design vs felt emotions.	*		*			P1 and P3 discussed how the model could specify that emotions refer to the emotions communicated through the design and not the felt emotions of the listening subject. P1 found the term emotions sufficient, but P3 suggested a distinction between objective emotions (the emotions expressed through the design) and subjective emotions (the felt emotions when experiencing a design).
The EPSI-model can easily be fitted into different design situations and activities.	*					P1 regarded the model to be easy to memorise and let the concept of the listening mode become second nature. The concepts of the EPSI-model can then be adjusted to fit into the design problem at hand.
Add methods and vocabularies to the EPSI-model.				*	*	P4a and P4b suggested to extend the EPSI-model with recommended methods and vocabularies to be used when inquiring into the different listening dimensions.

The three different versions of the EPSI-model

Figure 28-30 illustrates the different versions of the EPSI-model made from the empirical findings.

The first version

The second version of the EPSI-model has based created on the findings from the first empirical exploration.

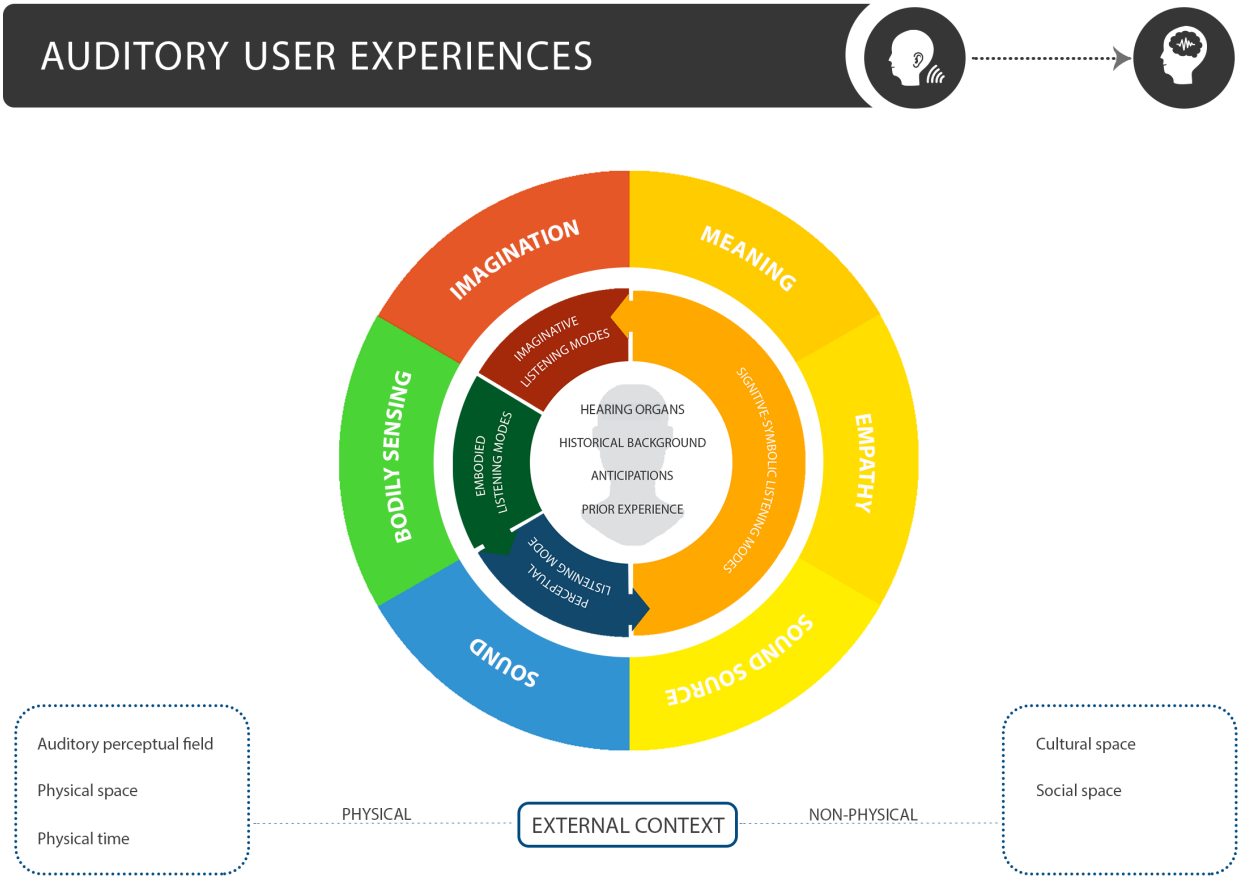

Figure 28: The first version of the EPSI model.

The second version

The second version of the EPSI-model has based created on the findings from the first empirical exploration and the first ME-session (P1).

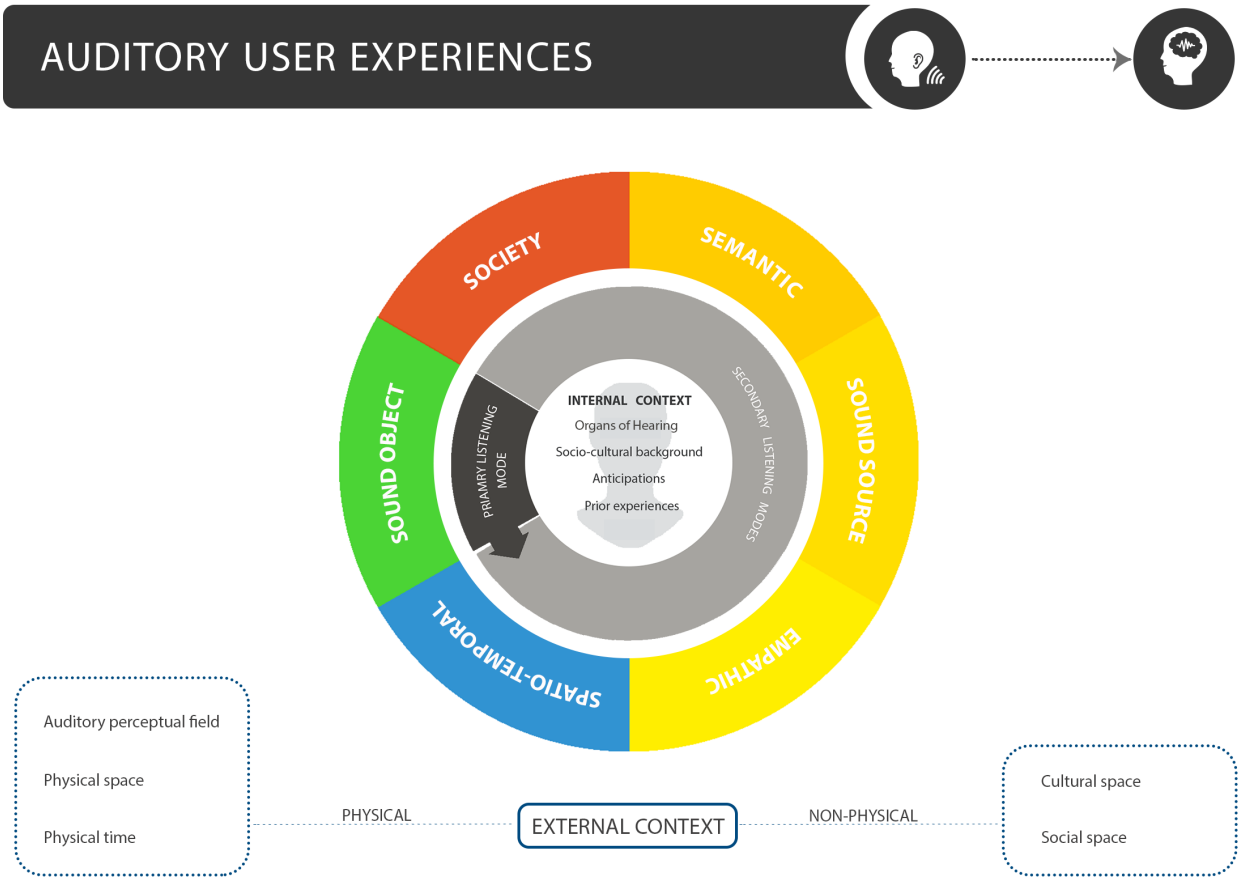

Figure 29: The second version of the EPSI-model.

The third version

The third version of the EPSI-model has based created on the findings from the second ME-sessions (P2).

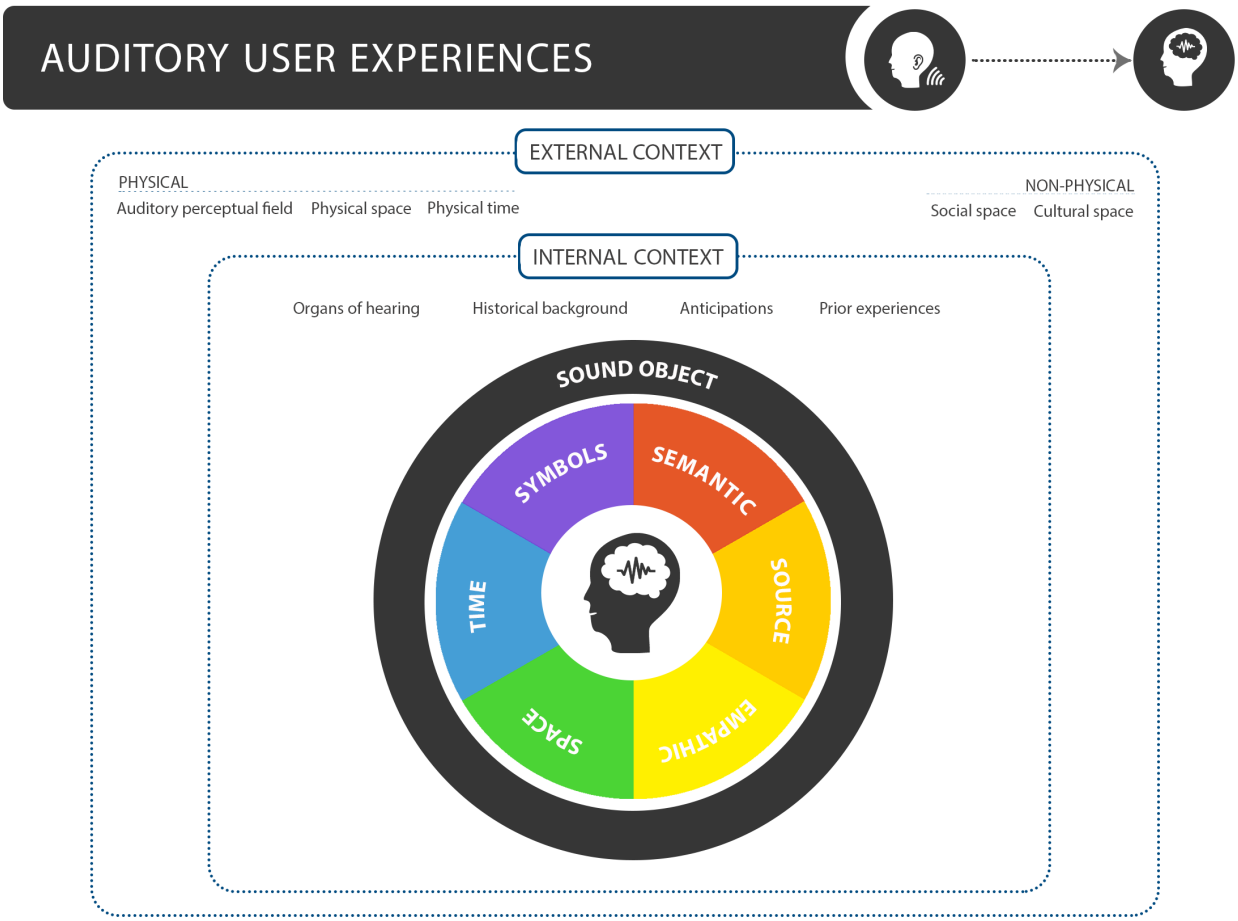

Figure 30: The third version of the EPSI-model.

In the next chapter, the findings from empirical explorations are discussed in relation to my theoretical groundwork, and the final version of the EPSI-model, the Sound Experience Model, is presented.

8. Discussion – the final model

Findings from the theoretical and empirical chapters will be discussed, and a final version of the EPSI-model, the Sound Experience Model, will be presented at the end of the chapter.

In this discussion chapter, the group of hearing aid users that were involved in the first empirical exploration are referred to as *informants* and the group of participants attending the ME-sessions are collectively referred to as *participants*.

To hear or not to hear

It comes as no surprise that the most intensely felt experiences of the informants where found within the embodied listening modes. The ability to hear previously inaudible sounds was the quality that showed the most intense positively emotionally felt experience, and the main reason for an overall positive assessment of the hearing aids. One informant describes this intensely felt experience as follows:

> "Nu kan jeg høre hvad der foregår bag mig, jeg kan sågar høre hvad folk taler om. Det er meget spændende, for før I tiden har jeg ikke kunne høre noget som helst, var jeg lige ved at sige. Jeg kan høre cyklerne når de kommer, og når der går nogen bag mig. Det er rigtig dejligt. Det har i hvert fald været en god oplevelse for mig.[52]" (DK1)

These strongly felt embodied sensations can be explained with the first position of this listening mode: To hear requires to take in sounds. The embodied listening mode, realises the sensorial

[52] "I can now hear what is going on behind me. I can even hear what people are talking about. It is very exciting because previously I could not hear anything. I can hear the bikes coming from behind, and when someone is walking behind me. It is really wonderful. It has been a very good experience for me." (English translation)

content of the acoustic actualities and turn them it into mental phenomena and can, therefore, be described as the primal impression in the direct perceptions. In chapter 4, we saw that Husserl understood the sensorimotor experiences as the most original part of experiencing. Not being capable of registering acoustic actualities means no other listening modes can be engaged, and poorly registered acoustical sensorial data affect all the other listening modes negatively which is evident in the statement made by P2 who experienced a poor playback quality in the ME-session:

> "This experience here where there is a voice layered through with background sounds, I really disliked all of it, but I think it was just because of the poor quality of the playback." (P2)

Since sound impressions are acoustic signals that impacts (touches) our body either through the ears or our nervous system, the embodied listening should be defined as a variety of the perceptual listening mode.

> "The vibrational nature of sound gives rise to our tangible as well as intimate experience of it. We can feel the vibrations, audible or not, of sounding objects whenever we touch them. But, they can be intimate and tactile even when we are not in contact with the sounding body – in dance club, for example, the powerful throbbing of subwoofers connects bodies and spaces, joining them in a singularly dense vibrating matter." (Franinovic & Salter, 2013, s. 51)

Thus, in the final version of the EPSI-model, listening in the perceptual listening mode denotes a directedness towards both the sensuous impact or audible structures of sounds indicating that sounds have both a vibrational and auditory dimension. The final model will be labelled the Sound Experience model, and sonic user experience will refer to both vibrations and audibility in subsequent pages of this thesis.

Unfamiliar perceptual fields

An experience that the Audiologist of [company] often found expressed by their clients was the mental exhaustion of getting used to the sounds offered by the hearing aids. As mentioned earlier in this chapter, the brain finds a way to cope with long time hearing loss, and when presented to previously unheard sounds, the brain has to adapt to the new situations and the overwhelming experience of all the new sounds. In chapter 4, experiencing unfamiliar perceptual fields was described as being a mentally demanding activity since the perceiving person could not rely as much on their natural attitude as when being surrounded by familiar perceptual fields. Relying less on the natural attitude means that our usual background intuitions are foregrounded, that is, our passive perceptions that we usually apply in our everyday situations become active, which puts a high load on our mental processes.

One technique used by the audiologists to minimize this exhaustion is to turn up the sounds slowly. In this way, the patient does not receive all the sounds at once, but gradually train the brain to take in more sounds. However, one audiologist from the interview stated that some people prefer the process of gradually getting used to new sounds, whereas others prefer to receive all the sounds at once to really sense the difference of having hearing aids. However, in the video diaries, only DK2 expressed this condition, while A2, DK1, DK3 and DK5 had the opposite experience, where they found the new auditory experiences with the hearing aids much less exhausting than living without hearing aids:

> "It takes too much mental efforts to live without hearing aids. You become exhausted and drained of energy because you have to concentrate all the time on what people are saying. Hearing aids make life so much easier. The energy it takes [...] how much concentration it takes when you can't hear, just that exhaustion itself is a reason to get hearing aids." (A2)

One positive side effect of using hearing aids mentioned by one of the informants was the functionality of automatically shutting down the hearing aids when sounds exceed a certain dB level out. In this way, he believed the hearing aids are protecting his ears from damaging loud sounds:

> "They [people at a Hindu temple] were having some kind of ceremony, and my wife took her smartphone with a decibel meter on it, and it was at least 100 dB sounds, so, if there is anything I like on my hearing aids, is when the sound is too loud, they will shut down and block my ears to protect them" (A1)

A widely acknowledge damage threshold for constant auditory exposure is 80-90 dB, however, a high number of everyday activities such as the use of power tools, lawn-moving, music listening and playing, construction work, hearing a train passing by easily produce sounds above this level. So, the shutting-down functionality of hearing aids could be a beneficial auditory service for normal-hearing people as well.

The fundamental position of the perceptual listening mode

Even though this mode is not directly being noticed or reflected upon, the perceptual listening mode is the first necessary step in the intentional directness towards acoustic actualities. This fundamental position of the perceptual listening mode was not apparent in the first two versions of the EPSI-model, which one of the participants noted:

> "Can you take a moment and explain why this [pointing at the perceptual listening mode] is in the circle? Because the way you just explained it, it sounds like there should be a foundational layer for this […] The circle suggests some kind of continuity or togetherness, and if you have something that is so foundational, it seems like you need to have another structure." (P2)

Being presented with the third version of the EPSI-model, P3 found the fundamental position of the sound object listening mode being illustrated very well. Even though sound object listening is somehow involved in all auditory experiences, P3 found it helpful to have an illustration that promotes a more detail description of how we experience through listening:

> "Den der sound object følte jeg kunne være det hele […] Hvis man begynder at snævre modellen ned, bliver der til sidst kun én ting at måle på. Man bliver nødt til at have de

der…[red. P3 peger på de andre listening modes] for at forstå det her […] Det kan godt være at du har en ting, der er dit sound object. Men, hvad udgør det? Det udgør alle de her [peger på de andre listening modes på modellen]." (P3)[53]

In space and time

The informants and participants of the empirical explorations were more focused on the relationship between sounds in a soundscape than on single sound elements, and they were also describing the sense of location and spatiality implied by the sound. The informants described their concerns with different types of acoustic territories and the participants were very much focused on the balance between the foreground and background, the sense of spaciousness and navigation in the evaluated sound design:

"Refrigerator humming about 15-20 feet away, and other people were sitting in the room visiting with six people around the table. I could hear voices better in the group, but the background noise was still there […] The fourth and last event of the day were at a school cafeteria, 40 people sitting at roundtables. Talking to people on either side was very difficult. Raising the volume make the sounds a higher pitch, but doesn't do anything for distinguishing one sound from another." (A1)

"Lyden bruges til at give stemning og til at give nogle hints til hvilken lokation han er i, og et hint til om han er i bevægelse eller ej. Og, så bruger de [red. lyden] som navigation" (P1)[54]

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[53] "I felt that this sound object could be everything […] If you start narrowing down the model, we will end up only having one thing to measure. You have to have those… [P3 points at the other listening modes] to understand […] You may have something that is your sound object, but what does it consist of? It consists of all these [P3 points at the signitive-objective listening modes in the model]" (English translation)

[54] "The sound is used to express mood and to give hints about the location and whether he is moving or not. Moreover, [sound] is used to help to navigate." (English translation)

These experiential descriptions lead us to the criticism of Schaeffer's bottom-up approach to sound studies put forward by Augoyard and Torgue in chapter 4. According to Augoyard and Torgue, sounds are a part of a complex acoustic ecology and should therefore not be investigated isolated when inquiring into lived auditory experiences; Auditory experiences are not the sum of single audible phenomena. Thus, reflections on the soundscape and the external environment have to be supported in the final Sound Experience Model. However, these reflections can be made on two levels; On one level, we have reflections of the soundscape itself, and on the other level, we have reflections of the external physical environment. The former belongs to the perceptual listening mode since it refers directly to the perceived sounds and the latter to the signitive-symbolic listening mode. The following two quotes illustrate this different directedness.

An example of a non-sonic noematic description of an environment:

> "Man har en fornemmelse af hvor han er henne […] Der er en speciel reverb der giver en fornemmelse af hvilket rum man er i. Man kan mærke at når han kommer ud på gaden, er han i et åbent rum pga. trafikken og den reverb der er […] Lige pludselig er det et andet grundlag han går på. Det lyder blødere." (P1) [55]

An example of a noematic description of a soundscape:

> "Jeg har faktisk problemer med det [red. lydeffekter i baggrunden]. Generelt fordi jeg kommer til at lytte utrolig meget efter hvad der foregår i baggrunden, fordi jeg synes det er utrolig interessant hvad der foregår i baggrunden […] Jeg bliver meget opslugt af det sound billede der kommer bagved […] Hvis jeg skulle designe, så vil jeg helt klart hellere have

[55] " You have a sense of where he is […] There is a unique reverb that gives a sense of the room you are in. You notice that when he comes out on the street, he is in an open space because of the traffic and the reverb […] Just suddenly, he walks on a different concrete. It sounds softer." (English translation)

> noget neutralt når der bliver talt eller helt skrue ned for det [red. baggrunden], så jeg ved hvor fokus er […].” (P3) [56]

Inspired by McCarthy & Wright’s spatiotemporal thread (see chapter 3, page 45), literature review (Franinovic & Salter, 2013) (Özcan & Egmond, 2005) (Bijsterveld & Krebs, Listening to Sounding Objects of the Past: The case of the Car, 2013) and the results from the first exploration and the first ME-session, I included a spatiotemporal listening mode in the second version of the EPSI-model.

> “As a medium, sound has particular spatiotemporal and material characteristics that distinguish it from other sensory modality. Any sounding object or structure is inevitability entangled in its spatial-environment context due to acoustic principles such as resonance, reverberation, diffraction and refraction. The same is true for its temporally emergent nature, which includes such things as the production of patterns and rhythms, behaviour over different time scales, and the ways in which sound is modulated by action over and in time.” (Franinovic & Salter, The Experience of Sonic Interaction, 2013, s. 42)

However, P2 who evaluated the second version of the EPSI-model found the term spatiotemporal too broad and vague. P2 requested specific definitions of space and time that explains the difference between the actual (the actual physical surroundings) and suggested space (surroundings implied by the sound such as the feeling of being in the city or underwater), as well as the difference between time properties related to the sound itself, and the presently felt time and historical time.

Thus, in the subsequent ME-sessions, I presented a third version of the EPSI-model where the spatiotemporal listening was divided into two separate listening modes; a listening mode pointed towards time, and a listening mode pointed towards space. The participants’ experiences with these

[56] “I actually have problems with [sound effects in the background]. Generally, because I often listen incredibly much to what's going on in the background, because I find it interesting to know what's going on in the background [...] I get very absorbed by background sounds [...] If I should design, I would definitely have something neutral when there is a voice talking or turning volume of the [background] down, so I know where the focus is […]” (English translation)

two listening modes varied. P4a regarded the dimension of space as belonging to sound source listening, while P3 and P4 defined space as being both the non-acoustical space and the soundscape. The concept of time was also difficult for the participants to grasp. Similar to P2, P3 suggested a division of time into two axes: One axis that holds present temporal aspects and the other axis that points towards a historical time:

> "Det er lige før tiden skal være delt i to. Der er ligesom to akser i den […] Der er den hvor vi sidder nu og hvor jeg føler om tiden med dig går hurtig eller langsom, og der er den hvor vi snakker om fortid eller nutid […] Inden for produktdesign er det vigtigt, i hvert fald for os, at vi laver produkter uden for den historiske tid. Den skal være almengyldig fordi det er produkter folk har i lang tid […]" (P3) [57]

I had the same problems in coupling spatial and time-based experiences with the listening modes when analysing the data from the video diaries. The concept of space and time seems to belong to both the perceptual and signitive-symbolic listening modes.

Hence, to couple spatial and temporal reflections to the relevant listening mode requires further investigations into how spatial and temporal properties could and should be defined and how they are best understood among UX designers and researchers.

However, based on the empirical findings, I decided to expand the definition of causal listening to include properties related to the sense of spaciousness, location and the spatial relation between the sounding objects and events. Thus, the causal listening mode will be described as an ecological listening mode, and its noematic class will be named environment. Environmental descriptions include descriptions of both acoustic and non-acoustic environments.

Inspired by P2 and P3, descriptions related to ecological listening will be separated into descriptions referring to the actual present environment and descriptions referring to non-present

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[57] "The time should be split in two. There seem to be two axes involved […] There is the axis describing where we sit now and where I feel if the time with you goes fast or slow, and there is one axis where we talk about the past or present […] In product design it is essential, at least for us, that we make products outside the historical time. It must be non-historical because people should keep the product for a long time […]" (English translation)

environments indicated by the sound. Thus, actual descriptions refer to spatial properties of the actual present environment such as the actual orientation and soundscape, and indicative descriptions refer to environmental properties implied by the sound such sound designs of urban settings.

In the ecological listening mode, both the informants and participants were valuating the aesthetical quality based on how naturalistic the found the sound:

> ”Apart from that, my first impression is really fantastic good sound. Natural sound.” (DK3)

> ”Den der dryppende lyd er lidt I overkanten. Den er lidt ekstrem I mine ører, den er alt for høj. Jeg vil aldrig opleve en dryppende lyd så højt. Når de nu prøver at lave det naturalistisk er det ikke godt.” (P3)[58]

Like space, the final version of the EPSI-model will also include a temporal listening mode that defines time on an actual or indicative level. Indicative time descriptions refer to descriptions of time detached from the felt present time such as past/present/future and modern/classic, and actual-time descriptions refer to descriptions of present time experiences such as the felt duration and rhythm of a sound. The following two quotes illustrate the differences:

An example of an auditory experiential description referring to time on an indicative level:

> “”Jeg føler virkelig at jeg bliver skudt tilbage […] Der er slet ikke nogen tvivl om at jeg er tilbage i tiden. Også selvom jeg ikke står foran kirken, så har jeg det som om jeg er helt tilbage hvor det sker. Det synes jeg virker super godt.” (P3)[59]

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[58] “The dripping sound is slightly on the top. It is a bit extreme in my ears; it's way too high. I will never experience a dripping sound so loud. If they try to make it naturalistic, they are not doing it well.” (English translation)

[59] “I really feel like I am back time [...] There is no doubt at all that I am back in time. Even though I do not stand in front of the church, I feel as if I am back where it happened. I think it works super well.”

An example of an auditory experiential description referring to time on an actual level:

> "The rhythm of the bell is nice […] It's very regular and very sturdy, and there is something calm and peaceful in the sturdiness of it." (P2)

The sound of nature

As opposed to the perceptual listening mode, the ability to hear Nature sounds had a strong positive emotional effect on the informants:

> "Tonight, there were very very light wind, but I could hear the sound that leaves make from my neighbours' cherry tree […] again a very positive experience" (DK4)

And:

> "What I found to be extremely unique was how crisp the sound of the birds singing while working. It is something that I am not used to hearing. To hear birds singing while I was out working was like music to my ears […] I listened to the birds' chirp and the leaves crackle. Sounded really good." (A2)

This finding suggests that the audiologists could look into ways of changing the weight in new hearing aid users' listening intentionality from the perceptual listening mode to the ecological listening mode until they have become more adjusted to the changed perceptual field. This change in listening focus may be effectuated through exercises where that urge new hearing aid users to make a note of all previously unheard environmental sounds.

However, not all new sounds were experienced as positive by the informants. Particularly the internally heard sounds caused negative feelings with tinnitus and the feedback sounds made by the hearing aids as the biggest concern. Other internally heard sounds that had a negative impact on the auditory experiences were the feedback sounds made by the hearing aids, the whistling sound of the wind and the sounds of chewing crunchy food. The perception of own voice being too loud or distorted also distracted the user:

> "Even my own voice sounds different. It is like having my ear plugged with water. I feel like I am underwater to some degree because my voice reverberates in my head, which is unnatural to me at this point. I am not used to this happening all the time." (A1)

Sonic environments

Placing considerations related to the soundscape and acoustic territories within the ecological listening mode is a decision that needs to be further discussions. On the one hand, a focus on the soundscape is a focus on the sonic dimension of the perceived sound, and on the other hand, soundscape considerations are tightly coupled with considerations of the non-acoustic environment.

My decision to place these considerations under ecological listening was made with the assumption that this placement would be more evident for the designer. However, further investigations are needed to validate this assumption.

Stressful acoustic environments were of great concern to the hearing aid users. These environments were described as acoustically chaotic with many different types of sounds and voices and would have been labelled as low-fi soundscapes by Schafer. The informants typically mentioned restaurants and grocery stores as acoustic territories they tried to avoid because of their low-fi quality.

The perceptual ability to discriminate between voices or picking out voices in a crowd (the cocktail party effect) is also a common problem among hearing aid users in the ecological listening mode, which were mentioned as a significant experiential problem by two of the informants:

> "In general, the situations where I need help hearing is when I am in a large crowd or public place. I have been in a crowd several times, and again the people I am talking to, their voice is just blended with all the other ones" (A1)

Emotions and empathy

The questions that sprung to mind when looking into the emotional aspect of sound experiences was: *Is it possible to apply an emotional listening mode by itself? Can we direct ourselves emotionally, or are emotions solely a felt quality of experiences?* At first glance, the emotional

aspect seems to be both a quality of the noema and a noema itself. It seems that without these noemata, there would be no (or different) emotional reactions. Thus, emotions should not be considered as a listening mode, but as a value component attached to the noema. If we take a closer look, the emotional aspect might be the reason why DK1 directs herself to the sounds around her. Emotions seem to be the centre of her experience – more than the sounds themselves: she is not concerned about the bike, but about the feeling of hearing the bike; and she is not concerned about what people are talking about, but on the feeling of being able to follow conversations. If she was not emotionally attached to the sounds, she might have directed herself differently, and not made the heard sounds into an experience. However, it is possible to assess emotionally felt experiences, that is, to describe the feeling of experiencing certain feelings (chapter 4 elaborate on this emotional twofoldness is elaborated). If we go back to Husserl's description of phenomena being experienced as an eidetic being, comprised of different perspectival "seeings", we can explain sonic phenomena as being comprised of different perspectival "hearings"; a sound can be thought of as a sounding object, as a sounding event, as a message, as a bodily vibration, as a suggest space and time, and as a feeling. The noema of sounds can be any of these dimensions, and thus the noetic-noematic structure can be emotional. As a consequence, emotional directness can be regarded as a noesis on its own.

> "[…] we 'view mental processes of others' on the basis of the perception of their outward manifestation in the organism. This empathic viewing is, more particular, an intuiting, a presentive act, although no longer an act that is presentive of something originary." (Husserl, 1982, s. 6)

For this reason and inspired by Husserl's quote above, I made a distinction between emotions and empathy where emotions refer to emotional reactions (i.e., effects) and empathy refers to a directness towards the emotional dimension of a sound. Thus, the listening mode directed towards the emotional dimension of sounds is termed the empathic listening mode, and the noematic class of this directedness is labelled empathy in the second and third version of the EPSI-model.

Concerning the intentional content of the empathic listening mode, P1 found it hard to relate to the term empathy, and prefer the term emotion:

> "Jeg vil mere bruge ordet *intended feeling*. Empati forstå jeg som at jeg kan sætte mig ind i en andens sted, og opfatte deres situation, hvilket giver mig en dybere forståelse for hvorfor de gør som de gør […] Emotion er et godt ord og meget bedre end empati." (P1)[60]

P3, who was presented with the term *emotion* as the intentional content of empathic listening (the third version of the EPSI-model), found it challenging to separate the emotional and empathic directedness and suggested to use the term objective and subjective emotions, where subjective emotions refer to the felt emotions when listening to a sound and objective emotions refer to the emotional dimension of sound:

> "Jeg bliver ved med at tænke *objective emotion*. Hvis du siger det til mig, vil jeg sige ok, jeg skal ikke fortælle dig hvad jeg føler, jeg skal bare fortælle dig hvad jeg mener den kunstner har puttet ind i det her […] Jeg synes ikke den [red. objective emotion] er helt spot on, men det er i hvert fald den måde jeg tænker på det." (P3)[61]

When asking whether empathy could be a better word for objective emotions, P3 disagree since the word empathy refers too much to the listening subject, which P3 found confusing.
Thus, in the final version of the EPSI-model, the term emotion will be applied to describe the classes of noemata derived from the emphatic listening mode.

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[60] "I prefer the word intended feeling more. I understand empathy as being in someone else's place and understand their situation, giving me a deeper understanding of why they do the way they do [...] Thus, emotion is a better word than empathy."

[61] " I keep thinking of the term *objective emotion*. If you [say objective emotion]. I will say ok; I'm not going to tell you what I feel, I just tell you what I mean that artist has put into this [sound design] [...] I don't think [objective emotion] is totally spot on, but at least that's the way I think about it." (English translation)

Anticipations and memories

Anticipations also had a notable influence on the informants' attitude and behaviour. Three of the informants avoided specific places because of an anticipation of too much noise; one informant waited for a long time to use hearing aids because he anticipated the sound to be of terrible quality, and two informants chose to wear hearing aids because they anticipated the experience of using hearing aids will be positive:

> "I expect the hearing aids to pick up the voices of the people who are talking, and I expect to hear, clear as a bell, everything that is going on in that conference call." (A2)

An audiologist from the [the company] explained that the longer a person has lived with an untreated hearing loss, the less he or she remembers the real sound. On the other hand, if a person starts too soon to wear hearing aids, the memories of the sounds without the hearing aids are too strong, and lead to a negative valuation of the experience with hearing sounds mediated through the hearing aids. Thus, memories of sounds are tightly coupled to anticipations, and they were both defined as an imaginative listening mode in chapter 6.

In chapter 4, anticipations were described as rooted in both prior experiences and our present engagement in the world, and they were present in all our experiential engagements with the world. Moreover, we specified anticipations and prior experiences on two levels: a micro- and macro level. On the micro-level, we have retentions and protentions, and on the macro-level, we have memories and anticipations.

This understanding leads us to the question of whether anticipated auditory experiences should be categorised as a listening mode or should be recognised as an always present mental process and thus belongs to internal context. The cognitive processes and the interrelated structures between anticipations, present experiences and memories are highly complex. Thus, for the scope of this project, the imaginative listening mode was not included in the second and third version of the EPSI-model and will not be included in the final version either. Hence, the final version of the EPSI-model only refers to intentionalities of direct acoustic perceptions, that is, intuitions of actual sounds. However, to stress their importance, prior experiences and anticipations will be illustrated as internal contextual factors in the model.

Connotative and denotative meanings

In my different versions of the EPSI-model, I found the concept of semantic listening challenging since I was interested in illustrating the difference between denotative and connotative meanings in a non-academic language. However, this translation was not a straightforward task. In the second version of the EPSI-model, I experimented with a distinction between society and semantics, where society referred to cultural symbols, implied sociality and political connotations. However, P2 found the term society confusing and unclear.

In the third version of the EPSI-model, I changed the word society to symbols. However, P3, P4a and P4b experienced difficulties in defining the difference between these two terms. This struggle may be explained by the fact that symbols are defined as a subcategory to semantics within linguistics, and can therefore not be separated. Moreover, did P4a find it problematic that the term semantic is defined differently within the audio industry:

> "That is the confusing part because the sound quality perception has always been called the semantics [within the audio industry]" (P4a)

In the audio industry, semantics correlates to my definition of perceptual listening and does therefore not point to the literal or suggested meanings behind a sound.

To simplify the final version of the EPSI-model, I chose to merge the denotative and connotative meanings into one and labelled this directedness semantic listening. However, the classes of intentional objects belonging to this listening mode will be referred to as Meaning to avoid any ambiguity. Thus, functional, informative and cultural decodings are all intentional objects of semantic listening. Interpreting sonification, earcons, auditory icons, speech and socio-cultural and political auditory messages are all content of the semantic intentionality.

To follow conversations was difficult for the hearing aid users

The ability to follow conversations and understand the content of what people were saying was the only semantically listening concern mentioned by the informants. This limited engagement of the semantic listening mode may be explained by the genre of audio products to which hearing aids belongs. The objective of hearing aids is to mediate the external sounds as smooth as possible, so the listening focus is on the external world and not on the hearing aids. Thus, the auditory interfaces

are created to be as invisible as possible, and the notifications sounds should be designed in a discrete manner. In the ME-sessions, semantic listening was mostly pointing to the content of the narrator's story:

"Jeg tænker ikke over hvad han siger fordi jeg fokuserer så meget på baggrunden." (P3)[62]

"Man kan forstå hvad der bliver sagt, men baggrundslyd er lidt forstyrrende" (P4b)[63]

Listening attitudes

In addition to listening modes, listening context and listening focus, a focus may also be put on listening attitudes or as proposed by Stockfelt, listening strategies. However, listening strategies implies a calculated approach to listening, whereas listening attitudes neither suggest a planned or unplanned approach and thus seem more appropriate. Listening attitudes can be defined as how we approach listening, whereas listening modes is about how we approach the intentional sound object. Thus, the concept of listening attitude correlates with the phenomenological definition of attitude and Gaver's interpretation of the listening activity. Our everyday approach to listening can be termed as the natural listening attitude or as the everyday listening attitude as proposed by Gaver. Musical listening defined as an attitude that tunes into sounds for a musical experience is also an example of a listening attitude, and Wiggen's Listen to music as a *sounding backdrop* can be translated into a background listening attitude. My empirical research supported the claim made by Schaeffer and Chion that the sound source listening mode and semantic listening mode were the most active listening modes in the natural listening attitude. The hearing aid users often described their auditory experiences through references to sound sources and the auditory experiential descriptions made by the participants in the second empirical exploration were mostly focused on describing the sound sources of the sound design. P2 even stated that the lack of ability to recognise the sources behind the sounds in the sound design and being unable to follow the story in the audio walk felt very uncomfortable.

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[62] "I don't think about what he says because I am so focused on the background." (English translation)

[63] "You understand what is being said, but the background noise is a bit disturbing." (English translation)

Other listening attitudes that appeared in the empirical research were the analytic and specialised attitude. The analytic listening attitude appeared in the way the hearing aid users and participants in the second empirical exploration analysed the sounds when evaluating their auditory experiences. The specialised listening attitude referred to people with a specialised approach to listening such as acousticians, musicians, musicologists, audiologists, sound designers and audio product designers, and specific vocabularies, epistemologies and methodologies often follow these attitudes. P3 and P4a from the second empirical exploration stated that expert listeners were often used in evaluating sessions. Expert listeners also apply a specialised attitude in their approach since they have been trained in focusing on specific qualities. However, trained expert listeners may not have a listening focus that matches the untrained users, and thus might give an incorrect picture of how the product is experienced in real use. P3 voiced this concern in the ME-session. Thus, evaluating through a natural listening attitude may be more appropriate in sound designs that are aimed at untrained listeners.

However, following the phenomenological definition of the natural attitude, the natural listening attitude will always be present no matter what other attitudes that are applied.

The listening context

Experiences documented through video diaries are only those that are defined as *an experience* by Dewey. Thus, the passive experiences of everyday life, which may provide valuable knowledge about the embodied listening mode and the influence of listening contexts and listening focus, are not approached. To approach these, observational methods have to be applied. Likewise, the influence of listening contexts and listening focus could not be investigated in the ME-sessions evaluating the 1807 app since the listening situation in the evaluation sessions differed a lot from the real listening situation. The 1807 app is supposed to be operated in urban settings, but the evaluations took place in office environments. P2, P4a and P4b emphasised the importance of evaluating in the real physical scenario to get an accurate evaluation of the product in use:

> "That [red., the ambience] will be taken into account if you do the evaluation in place. If we do an evaluation in an office environment like here, we will not get the right picture. The

> playback situation has to be close to the real scenario […] Standing in an urban environment with electrical things passing by and people shouting, it may be more difficult, and you may get a different evaluation of the sound." (P4b)
>
> "There are different ways that your immediate environment can influence that [auditory experiences]. It depends very much on the literal architecture of the space around you." (P2)

The perceptual field, when evaluating, has match the perceptual field of the product in real use. To emphasise the importance of the external context, P2 suggested to let a square representing the external context framing the listening mode circle. This viewpoint was also pointed out by one audiologist from the first empirical exploration who problematised their current practice of conducting hearing tests in labs instead of out in the real world. Thus, the results from the evaluations of the 1807 app cannot be considered as valid. However, the objective of the ME-sessions was not to give an accurate evaluation of the 1807 app but solely to illustrate how the EPSI-model can be applied in an evaluation session. However, the video diaries were recorded in the real settings of the user and the Blindscape game were played in a physical setting that matches the real scenario.

P3 also points out the strong effect contextual factors such as the visual design, sociality, status and convenience of the product have in the experience of audio products, where these external factors sometimes are considered more important than the sound quality itself. P1 also emphasised the importance of contextual awareness to understand preferences of the users. For P1, contextual data could be the time of the day, a location or season.

Moreover, P2 suggests to give the person icon in the middle of the model that represents internal context a stronger colour. P2 finds that the grey colour implies something that is in the background, which is a misleading way of communicating something as important and fundamental as internal context:

> "There is something about the person. Here the person is grey, and grey normally means *in the background*, *out of focus*, *not important,* and I find that a kind of weird since it is actually the person and the person's perceptions which are effecting everything else" (P2)

The final version of the EPSI-model has been changed according to P2's suggestions.

The EPSI-model as a design tool

A remarkable change in how auditory experiences were articulated was found in the more extensive descriptions made by the participants after the model was introduced.

Complications with the audio playback in the first ME-session made outside the IT University of Copenhagen meant that the participant P2 had a hard time hearing the content of the sound piece and therefore did not have the opportunity of experiencing the full narrative of the sound clip. The difficulties in identifying the sounds made it hard to describe and evaluate the different elements in the sound design. As a consequence, P2 could not complete the evaluation exercise.

Without the EPSI-model, P3 only evaluated on three instances of the sound design and all of them addressed the balance between foreground and background. With the EPSI-model, P3 evaluated on seven instances that involved the sound itself, the content of the story, the foreground-background balance, the soundscape design, the voice of the narrator, the sense of being back in time, and the emotions involved in the design. Hence, more than twice as many incidents were included in the experiential descriptions when applying the model as a guide. As stated in the previous chapter, it is vital to emphasise that listening to a second time, would automatically bring out more detailed descriptions. However, with more than twice as many identified instances, it can be assumed that the EPSI-model stimulated the participants' auditory experiential descriptions.

After being presented with the mode, P3 also made more detailed descriptions of all the experiential instances addressed in the sound piece.

P4a and P4b participated together in the ME-session, but it was only P4b who completed the first exercise, and there was no time to conduct the second exercise. Before being presented with the model, P4b suggested three areas to be looked into when evaluating a sound design. These areas are intelligibility, emotions and playback quality. Concerning the 1807 app, P4b evaluated on these

three areas. P4b described the sound quality experience as good without any distortion but argued that an evaluation setting has to be as close to the real scenario to give a valid result. P4b found the narrator's voice as occasionally being disturbed and difficult to follow. The atmosphere of the sound design suggested being back in time due to the church bell and a soundscape with no cars.

After the presentation of the model, P4b added to more instances to the evaluation: One referred to the sound sources, and the other one referred to the emotional aspect of the narrator's voice. P4b specified the auditory experiences by including a more detailed description of the sound source properties and how well they acted together and a more detailed description of the emotional properties of the narrator's voice.

P1 did not find more instances in the evaluate sound piece after being introduced to the model. However, P1 found that the model facilitated more structured, detailed and focused conversations about a sound design by promoted a holistic view on the different aspects in which sound can communicate:

> "Jeg synes det er en meget spændende model […] Hvis man skal lave noget lyddesign til produkter eller spil, vil modellen være helt oplagt. Den kan også være oplagt til hele det her univers vi går ind i med lydfeedback og tale til at interagere. Her kan jeg kan forestille mig at hver gang man vil lave et eller andet, der vil det her hjul kunne blive brugt til at beslutte hvad det er vi vil, og til at få idéer i forskellige retninger, der synes jeg den er rigtig stærk." (P1)[64]

Both P4a and P4b saw an opportunity for the EPSI-model to be used as a tool for designers in making sure that all relevant areas are considered in the sound design:

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[64] "I find this model very exciting […] If you have to make some sound design for products or games, using the model will be quite obvious. It can also be applied in the whole universe we go into with audio feedback and voice interaction. In these cases, I can imagine that every time you want to make something, this wheel can be used to decide what we want to do and [the model can be applied] to get ideas in different directions. I find that really strong." (English translation)

> "This suggests that as a designer you may ask questions especially related to some of these topics to make sure that you get all the way around on the areas you find important for your product […] To focus your evaluation." (P4b)

P3 argued that the EPSI-model has the potential to facilitate auditory UX designers in creating strategies for how to approach design, as well as being a tool for how to understand responses from user evaluations better:

> "Jeg kan kigge på den [P3 peger på modellens lytterdimensioner] og sige: Hvad skal jeg være opmærksom på? Omvendt har jeg også her en tool, der kunne sige hvad de her responses jeg har fået fra mine participants egentlig betyder […] Er der nogle ord vi har set andre steder før? Og, er de så blevet kategoriseret ind i modellen her? Der er helt klart noget der jeg kunne se brugbart […] Det kan bruges eksplorativt eller det kan bruges omvendt, hvis vi får noget ind. [red. Modellen] er faktisk noget der vil kunne drive en feature development, sound adjustments eller en sound experience evaluering i sig selv, fordi vil lige pludselig forstår hvad der egentlig bliver sagt, hvor [red. brugerbeskrivelserne] ikke længere bare er en blurret ting." (P3)[65]

According to P3, the EPSI-model can be used exploratively, such as to investigate how the different listening modes are engaged and verbalised, and it can be used analytically as a way to structure and describe qualitative data.

P1 agreed in this potential use of the EPSI-model and found it valuable as a tool for creating alignments between the designers in a design team, or between designers and users:

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[65] "I can look at it [P3 points to the model's listening modes] and ask: What should I be aware of? Conversely, I also have a tool that could say what the responses I have received from my participants really mean […] Are there any words we have seen elsewhere before? Have the words been categorized into the model, yet? This is clearly something I find useful […] The model can be used exploratively, or it can be used the other way around when we get something in. [The model] is actually something that could drive a feature development, sound adjustments, or a sound experience evaluation in itself, because we just suddenly understand what is actually being said, so [the user descriptions] are not just a blurring thing." (English translation)

> "Man kan som designer sige, at vi har været ude og evaluere på lyddesignet og det her er scoren, men passer scoren med det vi designede efter? […] Modellen skal kunne både kunne bruges til at aligne en gruppe, altså hvad er det vi gerne vil sammen, til at designe efter, til at analysere på, og til evaluere på. Så, har du en stærk model." (P1)[66]

P3 also argued that the EPSI-model is a promising tool for creating a common way of talking about auditory UX experiences that will make design processes more manageable, as well as a tool for creating listening profiles among users. Moreover, P3 believed that a knowledge of the different ways we might attend to sounds has the potentials of facilitating creative thinking when designing new ways of communicating auditorily. This belief is supported by P1, who also stressed the importance of knowing the different aspect of how sound communicates to create a design that better expresses the intentions of the designer.

P3 appreciated the idea of taking a starting point in the natural attitude of the user, instead of providing them with predefined vocabularies when asking them to evaluate their auditory experiences. Subsequently, the designer may apply the model as a tool to translate the users' descriptions into design strategies.

P4a understood the model as a sound perception model that can categorise sound-related descriptions to be used in design methods such as descriptive analysis. P4b and P4b also saw the model as a potent tool for categorising words, concepts and approaches in different design situations. However, P3 requested more specifications to the model to understand the components and definitions of the different listening modes better:

> "Jeg synes [red. modellen] er superfedt […] Det minder meget om de ting vi laver […] Hvis jeg så kunne få sproget herovre fra [red., modellen] og spørge hvad det er for nogle cues jeg skal kigge efter når jeg laver evalueringer. Jeg skal have noget baggrund her der

[66] " As a designer, you can say we have been evaluating the sound design, and this is the score, but does the score fit our intentions? […] The model must support alignments in a group, that is, to know which direction to go according to design, analysis and evaluation. Then, you have a strong model." (English translation)

hedder *når vi taler sådan og sådan* så går alt sammen ind under den her listening mode. Det kan være at det er noget jeg skal have upfront eller det kan være noget jeg først skal have når jeg skal analysere […] Så bliver det lige et pludselig super, super let kategoriseringsværktøj, og så er det de samme ting vi måler på altid […] Hvis vi kunne få en tool, hvor jeg ved at hvis jeg går ud og laver det eller [name of colleague] går ud og laver det, så vil det stadig være nogenlunde det samme resultat vi vil få. […] Og ved at inden for de her kategorier, der snakker vi om de her ting […] Det er så vigtig med en headline, for så kan vi lige pludselig begynde at sortere tingene ind under de her kategorier i stedet for at starter forfra hver gang." (P3)[67]

Even though P4b saw many advantages in using the mode, P4b regarded the EPSI-model as being primarily aimed at untrained designers to help them create awareness of sound's different perceptual perspectives:

"I see this as a tool that is helping people who are not experienced in how to do things. If you have done sound evaluations for 25 years you don't need it because you know what you are looking for, you understand, and you have a lot of relevant questions to ask. As a beginner, you will probably only look into one of them [pointing at one of the listening modes], and that is where you focus, because you may not be aware of all these other areas." (P4b)

[67] "I think [the model] is super cool [...] It is very similar to the stuff we do here [...] If I could just get the language from [the model] and ask what cues I should look for when evaluating. However, I need some background that says if we talk like this, then it refers to this listening mode. It might be something I need to have upfront, or it might be something I only need when analysing […] Then it suddenly becomes a super, super handy categorisation tool, and we will always measure the same thing […] If we could get a tool where I know that if I go out and do this or [name of colleague] go out and do that, then we will still get the same result, and knowing that within these categories, we talk about the same thing […] It is so essential with a headline, because then we can start organising things into these categories instead of starting from scratch every time." (English translation)

Conversely, as an experienced designer P1 regarded the EPSI-model as a tool that can easily be adjusted to fit different design situation and be combined with other design tools:

> ”Det vil en model man bruger nogen gange og lærer den at kende, og lige pludselig sidder den på rygraden. Så vil jeg nok lave en afart af den når jeg skal ud og lave en workshop eller konceptudvikling, hvor jeg udlade en dimension eller koble en ekstra på hvis det er nødvendigt […] For eksempel vil jeg kunne lave den lidt som et spider web, det kan man med de fleste modeller. På den måde kan jeg sige hvor meget jeg vil [fokusere på den ene dimension] kontra den andet. Den vil kunne hjælpe mig som designer med at aligne på tværs af et design team.” (P1)[68]

According to P1, experienced designers do often mix different methods and techniques depending on the design problem they have to solve and prefer agile approaches instead of rigid and inflexible procedures:

> “Nu skal jeg ikke generalisere hvad designere gør, men jeg er rimelig sikker på at de fleste designere vil sige at alt det de har i deres værktøjskasse, det forbliver i værktøjskassen. Hver gang de skal lave en test, så laver de et eller andet der passer lige præcist til det behov de har som er et samsurium af forskellige ting fra værktøjskassen. Det er ikke sådan at man har sådan nogle hylder hvor man går hen og læser sig frem til hvad man skal gøre […] Modeller er aldrig virkelighed, de er en abstraktion over virkeligheden. Nogen gange

[68] ” It will be a model you sometimes use and get familiar with until it suddenly sits on the backbone. Then I will probably make adjustments to it. When I do a workshop or concept development, I might leave a dimension or add an extra if needed [...] For example, I will be able to make it a bit like a radar chart; you can do that with most models. In this way, I can say how much I want [to focus on one dimension] versus another. This will help me as a designer to align across a design team.” (English translation)

bruger vi én model fordi den giver os noget, og nogen gange bruger vi en anden model for den giver os noget andet. Så, den vil indgå sammen med nogle andre modeller." (P1)[69]

This description of designers' work processes fits very well with Koskinen, Zimmerman, Binder, Redström and Wensveen description in chapter 2 (page 30).
P4a and P4b moreover suggested transforming the EPSI-model into toolbox by adding design and evaluation methods and vocabularies recommended for the different listening dimensions:

"It may be a help in that sense. If you can then add methods if you are especially looking into how do we improve the source thing: I get bad ranking at the source experience - how do I go further on that and how do I know more about what they mean? […] In cases where you don't have trained listeners, maybe this model can help to describe sound experiences." (P4a)

The listening modes

In the ME session, P3 found it challenging to categorise some of the auditory experiential descriptions since they seemed to be too complex to belong to just one listening category. As an example, P3 categorised the foreground/background-listening as perceptual listening and the pleasantness of the narrator's voice as a sound source listening. However, when describing the location of elements in a soundscape, we are also referring to properties of sound sources and thus applying an ecological listening, and referring to the pleasantness of the narrator's voice could also be perceptual listening since the focus is on the structure of voice. These examples illustrate that it is challenging to separate listening in such a bold way as the EPSI-model suggests.

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[69] " Now, I am not going to generalize what designers do, but I am pretty sure most designers will say that whatever they have in their toolbox, it stays in the toolbox. Each time they have to do a test, they make something that exactly fits the need they have, which is a mix of different things from the toolbox. It's not like you have a shelve where you go and read about what to do [...] Models are not reality; they are an abstraction of reality. Sometimes we will use one model because it gives us something, and sometimes we will use another model because it gives us something else. So, it will be used with some other models." (English translation)

I also experienced these difficulties when analysing the video diaries. Pierre Schaeffer also mentioned the problem of separating the listening modes (see Chapter 4). He explained that listening modes are often mixed up and difficult to separate from one another. Thus, a listening experience is often a mixture of many different listening modes. For instance, the following quote by A1 has elements of perceptual listening, ecological listening, as well as semantic listening:

> **"**I waited in the waiting area. There was a kiosk machine that made noise, like a cold beverage machine. The refrigerator compressor, the hum of it, was consistent and always there. I found that to be an inconvenience when listening to the voices of the check-in-desk" (A1).

However, I realised that when the informants applied more than one listening mode at a time, one (or sometimes two) listening modes seemed to be more dominant than the others

Thus, in the cases of conflicting listening modes, I applied a strategy of defining the experience based on the most dominant listening mode identified in the informants' experiential expressions. I did not follow the strategy suggested by Schaeffer that one should investigate the final applied listening mode in the range of applied listening modes. The reason for going against Schaeffer's suggestion is that I found it impossible to locate the last-applied listening mode. In lived experiences, listening is an ongoing process, where the listening focus and intentionality is continuously changing. Thus, describing listening modes in a chronological order turned out to be an impossible task.

P2, who was presented with the second version of the EPSI-model, found some of the listening mode categories confusing and unclear - particular the concept of spatiotemporal listening mode and the society listening mode. Thus, P2 only saw the EPSI-model as an interesting starting point:

> "I find the model an interesting starting point, but a lot of it is very confusing, and I need those things to become more clear before I can start to say how we could use it here." (P2)

Moreover, P2 found the colours of the listening modes misleading since the closely related colours of the empathic, sound source and semantic listening modes insinuated belongingness to each other. However, P2 found it unclear why these modes were not related to the spatiotemporal or society listening mode:

> "Maybe just reversing the colour scheme so that the things in the outer circle those are the ones in the shade of grey and the middle gets the colours." (P2)

P4b also found it challenging to interpret the listening modes in the right way and suggested to add textual or visual guidance to help the designer interpret or remember what the different listening modes refer to:

> "Jeg mangler noget der kan hjælpe mig med at tolke hvad er det de forskellige dimensioner betyder. Det vil derfor være fint med en underdeling eller nogle eksempler." (P4b)[70]

P4a and P4b furthermore suggested to link examples of possible design and evaluation methods and vocabularies to each listening mode:

> "It may be a help if you can add methods to the model. For instance, if you are looking into how to improve the sound source listening: I get bad ranking at the sound source experience - how can I move further on? How do I know more about what [the users] mean? […]" (P4b)

> "What could be valuable with this one is not just to have categories, but also a vocabulary for each of these categories." (P4a)

P4a also found it interesting to make a similar categorisation based on theories from linguistics instead of musicology:

[70] " I need something to help me interpret what the different dimensions mean. Therefore, a subdivision or some examples will be helpful." (English translation)

> “There must be some linguistic-based tools that categorise sounds based on similarities in words describing sounds. These tools could be compared with your approach” (P4)

The Sound Experience Model

The Sound Experience Model serves as a holistic and theoretical grounded guide for describing sound experiences. The Sound Experience model can be applied either as a way of identifying the qualities of the noemata from sound perceptions or as a way to identify noetic structures (i.e., what listening modes a listener applies). The noetic structures can be identified based on the user's auditory experiential descriptions (i.e., noemata). In the former, evaluations take their starting point in the listening modes upon which articulated auditory experiences are identified and structured. In the latter case, the starting point is on experiential descriptions, that is, engaged listening modes are identified based on experiential descriptions. In both cases, a designer can compare the engaged listening modes and the quality of the engaged listening modes with the design intentions. Thus, the auditory experiential framework not only has the potential of serving as a tool for describing, analysing and reflecting upon first-person auditory user experiences but also for identifying relevant design strategies, concerns, evaluation methods and what knowledge area to apply if the identified auditory experiences or listening modes do not correlate with the designer or researcher’s expectations. Design planning and evaluations involve reflections on potential design challenges and possibilities, and the framework can function as a reflection tool that helps to facilitate the designer in recognising possible, preferred and undesirable listening modes through which possible challenges and possibilities can be investigated. For example, evaluation of qualities related to the perceptual listening mode requires a different set of methods and questions than evaluation of auditory experiences that relate to the semantic listening mode. The former may be best evaluated through psychoacoustic evaluation methods and the latter through methods found within semiotics and socio-cultural sciences.

Additionally, the model can function as an auditory experiential vocabulary for creating common grounds between the designer and the end-users when discussing user experiences, as well as between the different stakeholders that are often involved in a product design process. Product design processes are often interdisciplinary, involving people with different professional

backgrounds, which stresses a need for a tool that can serve as a common platform upon which this diverse group of participants can communicate (de Vere, Kapoor, & Melles, 2010). This model serves as a means for designers, researchers and other stakeholders to engage phenomenologically in conversations related to auditory experiences through a comprehensive understanding of the constitutes of auditory experiential orientations and listening practices.

Figure 31 illustrates the Sound Experience Model, the final version of the EPSI-model. Following the model is a table (table 8) that offers the reader a detailed description of the possible vocabularies, research areas and design questions that applies to each listening dimension.

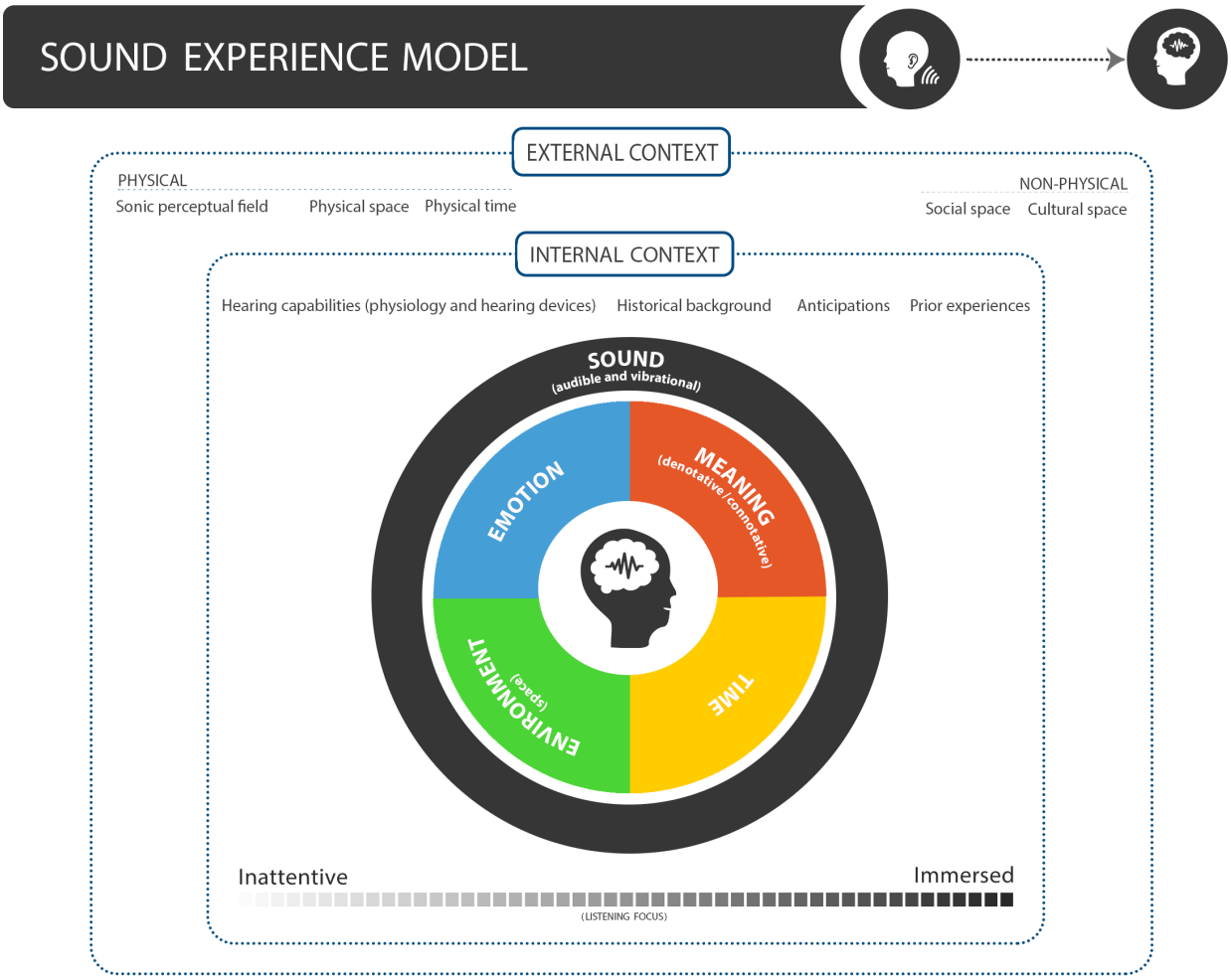

Figure 31: The Sound Experience Model.

Table 8: Examples of vocabularies, research fields and design questions that applies to each listening mode.

Noematic class	Vocabularies examples	Research area examples	Design question examples	
Sound (the audio and bodily felt dimension of sounds)	- Somatic expressions - Psychoacoustical terms (e.g., loudness, timbre, pitch, treble). - Onomatopoeic words - Musical terms and notations - Aesthetical qualities: (e.g., emotional reactions, bodily reactions, sound (transmission) quality, stimuli and thresholds measurements)	- Acoustics - Somaesthetics - Psychoacoustics - Musicology - Soundscape/acoustic ecology	How would you describe the rhythm and structure of the sound? In what way to do feel the sound?	Perceptual listening mode
Environment	- Descriptions of sound sources (objects, subjects and events) - Soundscape descriptions (e.g., hi-fi/low-fi environments, acoustic territories) - Actual or indicative spatial descriptions: o Sound structure (e.g., width/depth, balance) o Orientation (e.g., up/down, left/right, foreground/background) o Movement (e.g., Doppler effect) o Distance (close/distant) o Immediate location (e.g., I am inside/outside) o General locations (e.g., the game takes place in urban settings, underwater, etc.) o Abstract locations (e.g., heaven) - Aesthetical qualities (e.g., naturalistic, emotional reactions, the ability to identify sources and environments)	- Acoustics - Soundscape - Ecology - Sound design - Psychoacoustics - Musicology - Architecture - Cultural studies - Domains related to the sound sources.	How would you describe the soundscape of the game? What acoustic environments do you dislike? How would you describe the location implied by the sound?	Ecological listening mode
Time	- Actual or indicative temporal descriptions (e.g., rhythms, dynamic behaviours, duration, pace, classic/modern, past/present/future) - Onomatopoeic words - Aesthetical qualities (e.g., the felt time correlates with the	- Acoustics - Psychoacoustic - Musicology - Music	How do you experience the duration and rhythm of the song? Does the soundscape suggest	Temporal listening mode

	designers' intentions, emotional reactions)		an environment of the 1800th century?	
Emotion	- Emotional descriptions (e.g., happy, sad, exciting) - Aesthetical qualities (e.g., emotional reactions, the felt emotions correlates with the designers' intentions)	- Somaesthetic - Musicology - Music - Psychology - Emotion research	How would you describe the emotional design of the game? What moods did you experience in the game?	Empathic listening mode
Meaning	- Descriptions of the sound design's narrative. - Descriptions of the informative and functional aspect of the sound design. - Descriptions of speech and intelligibility. - Aesthetical qualities (e.g., emotional reactions, intelligibility, understanding the narrative and function of the design)	- Socio-cultural studies - Political studies - Social science - Communication - Media studies - Psychology - Linguistics - Narratology	Can you explain the narrative of the audio game design? What does the notification sounds mean? How would you describe the lyrics in the song? Does the song convey any political messages?	Semantic listening mode

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9. Conclusion and future directions

"Scientific discoverings are systematic fumbling in the dark"
(Karl Friederich Gauss, 1777-1855)

The objective of the thesis was to inquire into how auditory experiences can be systemised through resources derived from phenomenology and musicology.

By applying concepts from Husserl, Schaeffer, Schafer, Aygoyard, Rösing and Stockfelt, I proposed a theoretically grounded framework and translated it into a model in which auditory experiences can be described, analysed and evaluated. I refer to the final model as the Sound Experience Model to embrace the audible as well as the vibrational characteristics of acoustic signals. The Sound Experience Model is grounded on the phenomenological concept of perception, intentionality, noematic-noetic structures and actional-modes, and shaped by experiences from empirical explorations. This philosophical and explorative work resulted in a model that divides listening into five listening modes; perceptual listening, empathic listening, semantic listening, temporal listening and ecological listening. The ambition is to provide a foundation for structuring sonic experience that is pragmatic and accessible across different fields and to designers with different expertise levels. Thus, the listening modes are represented through their noematic couplings and labelled in a colloquial language. These five noematic couplings are Sound, Emotion, Environment, Time and Meaning.

The listening modes are framed by internal and external contexts to illustrate the relational structure between listening mode, context and listening focus. Moreover, the signitive-symbolic listening modes are frame by the perceptual listening mode to emphasise the experiential dependency. By accepting this model, it becomes possible to make a detailed and structured description and analysis of all kinds of data that takes a starting point in subjective first-person sonic experiential descriptions.

In the first empirical exploration, the Sound Experience Model was investigated as an analytic tool, and in the second empirical exploration, its potentials as being a tool for evaluation was investigated. These empirical explorations revealed the Sound Experience Model's high potentials in functioning as a categorising tool for aligning sonic experiential descriptions and evaluations across design teams and for creating a common ground for experiential inquiries. The findings from the empirical investigations moreover implied the possibility of evaluating listening experiences on different aesthetical levels

Listening is such a central part of auditory experiences. The immediate and continually present characteristics of listening have resulted in it being taken for granted. Only a few practitioners within user experience design reflect on this highly fluctuating and multidimensional sense, where auditory design often is treated as a supportive module for the visual design. However, in the last decades, there has been a growing interest in the complexity of listening structures and the possibility of audio-based communication design within HCI and Interaction Design. Nonetheless, an easily accessible tool that provides a theoretically grounded overview of the human auditory experiential structures for interaction designers is challenging to find.

No matter whether we listen to music, conversations, birdsong, the wind in the trees or to the constant hum of traffic, some level of attention and intentionality is always involved, and these are shaped by a complex pattern of contextual factors belonging to socio-cultural practices, the acoustic environment, the physical time and space, hearing abilities, anticipations and prior experiences. Transcendental phenomenology addresses this pattern of complexity in their attempt to provide an ontological-neutral way of describing the most fundamental aspects of what it means to experience anything at all, and by avoiding any causal explanations and assumptions of why things exist or how they ought to exist. Thus, to take a phenomenological perspective on user experience has the potential to alter the way we understand and evaluate sound experiences. In the traditional auditory evaluations, psycho-acoustics and stimuli-responses are often the only experiential values to be measured. The implication of this for interaction design is that the human experience is often reduced to usability testing, behavioural reactions and psychoacoustic qualities. Extending the boundary of this view allows us to create a more nuanced and explorative understanding of the human auditory experiential system.

The guiding research question of "how to develop and formalise philosophical concepts of experience and listening into a practical tool for user experience designers and researchers to describe, analyse and evaluate auditory experiences?" has been answered through the Sound Experience model. Thus, the Sound Experience model fulfils the goal of this thesis of developing a tool that can facilitate researchers and designers in evaluating and communicating auditory user experiences.

Creating a tool that should support an interpretive and pragmatic ontology has to maintain the following premises:

- It should support investigations of the external world as it appears before the user (i.e., data expressed from a first-person point-of-view).
- It should support the possibility of informants having various experiences related to the same external occurrence.
- It should acknowledge that the lived body is situated in a physical, social, and cultural world.
- It should acknowledge the complex and fluctuating nature of the human mind and experiential structures.
- Our directness to the world is an active process; thus listening is an active process.
- The tool should not be normative or prescribe specific design and evaluation processes, but be open for different methodologies, beliefs and design situations.
- The tool should be comprehensible and written and presented in an accessible form.

Thus, how auditory user experience can be researched and described based on a meta-theoretical philosophy has been demonstrated in this thesis. The Sound Experience Model holds the above premises in acknowledging the fluctuating, ephemeral and subjective nature of experience. Additionally, the Sound Experience Model seeks to go beyond any applied scientific attitudes by offering a descriptive rather than normative platform, a platform that can be used by any scientific methodologies and practical design approaches. Whether one is inquiring into psychoacoustic values or culturally derived meaning-creation, this model is suitable, since it does not claim any correct way of researching into user experiences, but instead offers the researcher and designer an

overview of possible ways auditory experiences can be understood – each with its own knowledge domain and epistemology. Lastly, the Sound Experience Model does not make any claims about the content of sound-based user experiences or words to use when expressing these experiences, and thus supports subjective and changing experiences. Aiming at creating a tool for both theoretical and practical use, I applied the model as a tool for analysing user experiences. Subsequently, the model was evaluated by product design professionals as a tool for describing and evaluating sound-based user experiences to explore its possible strengths and weaknesses as a practical design tool. Thus, the empirical studies functioned as a supplementing strategy of inquiry to explore the practical application of the research findings.

The objectives of framing experience through a phenomenological lens, constructing an experiential framework and translating this framework into a model that can serve as a guiding tool for communicating and evaluating auditory experiences, were all met in this current thesis.

The Husserl's transcendental phenomenology was chosen as the philosophical basis for my enquiry into the concept of experience. This was done for three reasons: firstly, phenomenology is often conceived as a philosophy of science and thus claim to be independent of any scientific attitudes and presumptions; secondly, the phenomenological account of experiences takes a starting point in the lived life of people; and thirdly, Husserl's phenomenological approach is descriptive, which makes it supportive to any methodological and epistemological approaches. The phenomenological philosophy claims that it is not possible to grasp the whole world or the identity of objects in the world. As humans, we are only able to experience the world from our bodily and mental position, and the quest of describing the true essence of phenomena thus requires explorations from as many different perspectives as possible. To know about these possible perspectives in human listening practices is an important step to determine the essence of any subjective auditory user experiences.

One of the key concepts of Husserl's phenomenology is intentionality, which provides a powerful tool to describe user experiential structures that rest on an interpretive ontology. Intentionality rejects the Cartesian dualism by linking the subjective internal experience with the objective external world through our active directness to the world. The two different types of intentional objectivations identified in this thesis, the direct perception and a signitive-symbolic objectivation, which formed the basis for all the listening modes in the Sound Experience Model.

To relate the findings from my phenomenological enquiry into experience, I paralleled my findings with seminal theories of listening practices found within musicology, which has a long tradition of theorising listening practices from a non-engineering, interpretive point of view. By turning to musicology, I expanded the perceptual and signitive-objective listening modes found in Husserl's phenomenology with further dimensions to the model. Through Pierre Schaeffer and Michel Chion's concept of listening modes, Schafer's concept of soundscapes, and Augoyard & Torgue's acoustic territories, two more listening modes were identified: the ecological listening mode and the semantic listening mode. From Husserl's empathic directedness and Helmut Rösing's theory of listening reception, I defined the empathic listening mode, and from Wright & McCarthy experiential threads and Salter & Franinovic's spatiotemporal reflections, a temporal listening mode was added to the model.

By synthesising these findings, an experiential framework was constructed with four overall listening modes: the *perceptual*, *empathic*, *temporal* and *ecological* listening modes.

Moreover, the findings recognised listening focus and listening contexts as essential factors to include when evaluating experiences. Listening attention is described as inattentive, attentive, and immersed, and contextual factors include the physical environment, hearing capabilities, prior experiences, anticipations and personal background.

The primary intention behind this project is not to give highly specific recommendations for auditory interaction design. The aim is rather to raise awareness of the multidimensional aspect of human listening and to construct an approach that is sensitive to this awareness.

Future directions

One key issue a hearing aid user find problematic in their meeting with the HCP (Hearing Care Professional), is to express their auditory experiences. Audiograms help detect the audible defects and the EPSI model provides an overview of the dimensions related to auditory experiences, but communicating the content of everyday auditory experiences, and the quality of this content, is challenging since no shared or standardised vocabulary exists to express these experiences. The empirical data showed that our vocabulary for describing auditory experiences are very limited. The

difficulties in articulating auditory experiences were also found in Bijsterveld & Krebs' historical review of the auditory communication in the automotive industry:

> "Theoretical understanding of automotive technology was seen as a prerequisite for the auditory diagnosis of engine trouble yet insufficient for identifying audible malfunctions. Until one actually heard a piston slap, no written description could communicate what is sounded like […] One key issue chauffeurs, self-drivers, and even car mechanics had to deal with in the process of diagnostic listening was the verbalization of sonic experience. Tables, listings, and fault trees could help investigate audible defects. Less clear, however, was how mechanics should know what handbook authors exactly meant when they referred to, for instance, knocking sounds" (Bijsterveld & Krebs, 2013, s. 18,21).

The technological terms used by acoustic engineers, sound designers and audiologists are often incomprehensible for non-specialists who often use metaphors from their everyday lives, or from historical and socio-cultural contexts to express their auditory experiences.

P1 and P3 also expressed a need for a vocabulary that can bridge the gap between experts and non-expert listeners. P3 found it challenging to talk about sound with users because existing normative vocabularies are often too difficult to understand either because the words are too technical, too complex or because the words do not refer to anything meaningful for the user. P2 finds that the terminology applied when talking about auditory experiences is too often taking an acoustician's perspective instead of the lived experiences of the user:

> "Jeg synes vi mangler ord. Vi mangler nogle dagligdags ord til at beskrive lydoplevelser […] Vi har ikke noget sprog til at kommunikere det ud vi oplever gennem lyd." (P2)[71]

P3 requested words that describe sounds from a perspective that goes beyond psychoacoustics and onomatopoeia, as found in graphical design:

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[71] "I think we lack words. We lack some everyday words to describe auditory experience […] We have no language to communicate what we experience through sound" (English translation)

> "Som for eksempel ved farvebrug […] Som når det er rødt så er det højest sandsynligt noget der er galt hvis du er i Europa og i USA. Hvis det er grønt er det nok ok, og hvis det er gult skal vi begynde at passe lidt på. At få noget af det samme inden for lyd vil være det første skridt" (P2)[72]

A method that has been applied within sonic interaction design for articulating auditory phenomena is vocal sketching. Vocal sketching is a methodology where non-verbal sounds are used to communicate auditory thoughts and ideas (Ekman & Rinott, 2010). This tool seems to have great potential in evaluation settings, and inquiries into whether this tool compensates for or outperforms current practices could be highly valuable for interaction design practices.

The UX designers of [the company] considered the difficulties in meeting the expectations of their users as their greatest design challenge, and the main reason for people to give up on their hearing aids. One of the UX designers expressed a great need for a tool that can visually illustrate the auditory experiences of wearing hearing aids to make the experience of sound mediated through hearing aids more comprehensible by new users. This tool needs not only to illustrate what hearing aids can do but also, and just as importantly, what they cannot do.

P3 also expressed a need to communicate sounds visually. P2 finds it easier to talk about sound through visual abstractions and requested more research into how sounds can be described visually like when turning up the volume is visualised as a bar growing in length. P2 also believes that the sound design can find some inspiration from our intonation in the way we talk.

The present thesis is concerned with describing the different dimensions of auditory experiences, and applying a metaphorical strategy or other ways to articulate auditory experiences related to the different listening mode, seems to be a natural next step to take in the journey of uncovering "How we talk when we talk about sounds".

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[72] "As for example with colours […] Like when the colour red means something is wrong if you are in Europe or in the US. If the colour is green, then it is probably ok, and if the colour is yellow, we should take some care. Having something similar in audio design will be the first step" (English translation)

The Sound Experience Model is considered as the first step into creating a common theoretical ground for describing sonic experiences. The focus in this first step has been on describing listening experiences as noematic-noesis structures and evaluating this experiential approach from a practical perspective. Future research includes further investigations of how listening focus and context influences sonic experiences, a deeper understanding of the relations between direct perception, memories (retentions) and anticipations (protentions), and an inquiry into how the listening modes and, thus, the Sound Experience Model can be further specified and explained.

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11. Appendices

Appendix 1: Overview of findings from video diary of informant A1

Some of the points are followed by a small specification and other points are specified with a quote directly from the diaries. Most of the points are only presented as headlines due to confidentiality.

The different topics in each scheme have been rated for its intensity and aesthetical value in the analysis process, but due to confidentiality these ratings are not included in the presentation. The experiential descriptions were chosen for the level of felt intensity, and the rating was made on a scale from (---) to (+++). (---) refers to a terrible experience, (--) bad experience, (-) inferior experience, (-+) neither a bad or good experience, (+) good experience, (++) great experience, and (+++) amazing experience.

Listening modes	
Embodied listening mode (bodily directness)	• **Ears clogged with wax:** Clogging of wax in the ears makes it difficult to hear. • **Sensations related to the physical ears.**
Embodied listening mode (directness of hearing aids)	• **Adjusting the hearing aids to the capture specific sounds.** • **Comfortability of hearing aids**. • **Protects ears from loud sounds.**
Perceptual listening modes (outer)	• **The transmission quality of the TV.** • **Detection of soft sounds.**
Perceptual listening (inner)	• **Own voice sounds different:** "Even my own voice sounds different. It is like having my ear plugged with water. I feel like I am underwater to some degree because my voice reverberates in my head, which is unnatural to me". • **Crunchy sounds while eating:** "When I am eating I hear the chewing noise very loud in my head […] For the most part it wasn't a problem, but when watching a show I was eating some cookies and some nuts that are very crunchy, and I had to stop eating them when there was a dialogue because I couldn't hear what was going on. The crunch in my head was so loud". • **Tinnitus**

Signitive-symbolic (Causal)	• **Pick out a voice from a crowd**
Semantic listening	• **Following conversations**
Other listening (iconic?)	• **Sounds are distorted.**
Listening attention	
Incidental	• **Humming sounds in the background**.
Listening context	
Acoustic environment	• **Background sounds**.
Conclusive remarks	
• **Applied listening modes:** o Bodily directness o Perceptual listening mode o Causal listening mode • **Dominant listening mode(s):** semantic and causal.	

Appendix 2: Overview of findings from video diary of informant A2

Some of the points are followed by a small specification and other points are specified with a quote directly from the diaries. Most of the points are only presented as headlines due to confidentiality.

The different topics in each scheme have been rated for its intensity and aesthetical value in the analysis process, but due to confidentiality these ratings are not included in the presentation. The experiential descriptions were chosen for the level of felt intensity, and the rating was made on a scale from (---) to (+++). (---) refers to a terrible experience, (--) bad experience, (-) inferior experience, (-+) neither a bad or good experience, (+) good experience, (++) great experience, and (+++) amazing experience.

Listening modes	
Embodied listening mode (bodily directness)	• **Concentration and mental effort.**
Embodied listening mode (emotional directness)	• **Feelings related to the regaining of hearing.** "What I found to be extremely unique was how crisp the sound of the birds singing while working. It is something that I am not used to hearing. To hear the birds singing while I was out working was like music to my ears […] I listened to the birds' chirp and the leaves crackle. Sounded really good […] it was nice hearing the birds chirping […] I could hear the whoosh of the wind".
Embodied listening mode (directness of hearing aids)	• **Comfortability of hearing aids**. • **Look of the hearing aids.** • **Wants the hearing aids to become a part of the lived body.**
Perceptual listening modes (outer)	• **The transmission quality.**
Signitive-symbolic (Causal)	• **Picking out sounds in the environment.**
Signitive-symbolic (semantic)	• **Follow conversations**. • **Comprehending notifying sounds.**
Listening attention	
Selective	• **Listening to nature sounds and people talking.**
Listening context	
Acoustic environment	• **Experiencing new sounds.**

Social	• **Communicate with people.** • **Relationship to the hearing care professional.**
Conclusive remarks	

• **Applied listening modes:**
  o Bodily directness
  o Emotional directness
  o Directness of hearing aids
  o Perceptual
  o Causal
  o Semantic
• **Dominant listening mode**: Emotional	

Appendix 3: Overview of findings from video diary of informant DK1

Some of the points are followed by a small specification and other points are specified with a quote directly from the diaries. Most of the points are only presented as headlines due to confidentiality.

The different topics in each scheme have been rated for its intensity and aesthetical value in the analysis process, but due to confidentiality these ratings are not included in the presentation. The experiential descriptions were chosen for the level of felt intensity, and the rating was made on a scale from (---) to (+++). (---) refers to a terrible experience, (--) bad experience, (-) inferior experience, (-+) neither a bad or good experience, (+) good experience, (++) great experience, and (+++) amazing experience.

Listening modes	
Embodied listening mode (emotional directness)	• **Feelings related to the regaining of hearing:** ”Nu kan jeg hører hvad der foregår bag mig, jeg kan sågar høre hvad folk taler om. Det er meget spændende, for før i tiden har jeg ikke kunne høre noget som helst, var jeg lige ved at sige. Jeg kan høre cyklerne når de kommer, og når der går nogen bag mig. Det er rigtig dejligt. Det har i hvert fald været en rigtig god oplevelse for mig”.
Embodied listening mode (bodily direction)	• **Spatiality**.
Causal listening mode	• **The ability to hear the sounding objects in the environment.**
Semantic listening mode	• **Following conversations.**
Listening attention	
Selective	• **Attends to sounds in the environment**.
Listening context	
Spatial environment	• **Attends to the location and movement of sounding objects**.
Conclusive remarks	

• **Applied listening modes:**
  o Emotional.
  o Causal listening:
  o Semantic listening:
• **Dominant listening mode**: Emotional	

Appendix 4: Overview of findings from video diary of informant DK2

Some of the points are followed by a small specification and other points are specified with a quote directly from the diaries. Most of the points are only presented as headlines due to confidentiality.

The different topics in each scheme have been rated for its intensity and aesthetical value in the analysis process, but due to confidentiality these ratings are not included in the presentation. The experiential descriptions were chosen for the level of felt intensity, and the rating was made on a scale from (---) to (+++). (---) refers to a terrible experience, (--) bad experience, (-) inferior experience, (-+) neither a bad or good experience, (+) good experience, (++) great experience, and (+++) amazing experience.

Listening modes	
Embodied listening mode (bodily directness)	• **Concentration and mental efforts**.
Embodied listening mode (direction of hearing device)	• **Comfortability.** • **Adjusting the hearing aids.** • **Phone calls made through the hearing aids.** • **Program modes.**
Perceptual listening mode (outer)	• **The quality of the sound transmission** • **Music listening.**
Perceptual listening mode (inner)	• **Tinnitus**.
Causal listening mode	• **The ability to hear the sounding objects in the environment.**
Semantic listening mode	• **Music listening.**
Other listening modes (iconic)	• **Distorted sounds.**
Listening attention	
Selective	• **Attends to the sound quality.**
Listening context	
Physical environment	• **Wind noise.**
Conclusive remarks	
• **Applied listening modes:**	

- Perceptual listening mode:
- Causal listening:
- Other listening mode (iconic)

- **Dominant listening mode**: Perceptual

Appendix 5: Overview of findings from video diary of informant DK3

Some of the points are followed by a small specification and other points are specified with a quote directly from the diaries. Most of the points are only presented as headlines due to confidentiality.

The different topics in each scheme have been rated for its intensity and aesthetical value in the analysis process, but due to confidentiality these ratings are not included in the presentation. The experiential descriptions were chosen for the level of felt intensity, and the rating was made on a scale from (---) to (+++). (---) refers to a terrible experience, (--) bad experience, (-) inferior experience, (-+) neither a bad or good experience, (+) good experience, (++) great experience, and (+++) amazing experience.

Listening modes	
Embodied listening mode (directness of hearing aids)	• **Microphone.** • **Program modes.** • **Talking on the phone through the hearing aids.**
Perceptual listening mode (outer)	• **Transmission quality.**
Causal listening mode	• **The ability to hear the sounding objects in the environment.** • **Hearing new sounds.**
Other listening modes (iconic)	• **Natural sounding sounds.**
Listening attention	
Selective	• **Attends to the sound quality and new sounds.**
Listening context	
Environment	• **Nature sounds in the surrounding environment.**
Conclusive remarks	

• **Applied listening modes:**
  ○ Perceptual listening mode:
  ○ Causal listening:
  ○ Other listening modes (iconic)
• **Dominant listening mode**: Perceptual and causal	

Appendix 6: Overview of findings from video diary of informant DK4

Some of the points are followed by a small specification and other points are specified with a quote directly from the diaries. Most of the points are only presented as headlines due to confidentiality.

The different topics in each scheme have been rated for its intensity and aesthetical value in the analysis process, but due to confidentiality these ratings are not included in the presentation. The experiential descriptions were chosen for the level of felt intensity, and the rating was made on a scale from (---) to (+++). (---) refers to a terrible experience, (--) bad experience, (-) inferior experience, (-+) neither a bad or good experience, (+) good experience, (++) great experience, and (+++) amazing experience.

Listening modes	
Embodied listening mode (directness of hearing aids)	• **Streaming of sound.**
Perceptual listening mode (outer)	• **Transmission quality**
Listening attention	
Selective	• **Attends to sound qualities.**
Conclusive remarks	
• **Applied listening modes:** ○ Perceptual listening mode. • **Dominant listening mode**: Perceptual.	

Appendix 7: Overview of findings from video diary of informant DK5

Some of the points are followed by a small specification and other points are specified with a quote directly from the diaries. Most of the points are only presented as headlines due to confidentiality.

The different topics in each scheme have been rated for its intensity and aesthetical value in the analysis process, but due to confidentiality these ratings are not included in the presentation. The experiential descriptions were chosen for the level of felt intensity, and the rating was made on a scale from (---) to (+++). (---) refers to a terrible experience, (--) bad experience, (-) inferior experience, (-+) neither a bad or good experience, (+) good experience, (++) great experience, and (+++) amazing experience.

Listening modes	
Embodied listening mode (emotional directness)	• **Feelings related to regain of hearing**.
Embodied listening mode (directness of hearing aids)	• **Comfortability.** • **Phone call through the hearing aids.** • **Handling the volume on the hearing aids through the phone**
Perceptual listening mode (outer)	• **Hearing in noisy background.**
Listening attention	
Incidental	• **Background sounds.**
Listening context	
Acoustic environment	• **Background sounds.**
Conclusive remarks	

• **Applied listening modes**
  ○ Bodily directness:
  ○ Emotional directness:
  ○ Perceptual listening mode:
• **Dominant listening mode**: Perceptual and emotional	

Appendix 8: Overview of findings from video diary of informant DK6

Some of the points are followed by a small specification and other points are specified with a quote directly from the diaries. Most of the points are only presented as headlines due to confidentiality.

The different topics in each scheme have been rated for its intensity and aesthetical value in the analysis process, but due to confidentiality these ratings are not included in the presentation. The experiential descriptions were chosen for the level of felt intensity, and the rating was made on a scale from (---) to (+++). (---) refers to a terrible experience, (--) bad experience, (-) inferior experience, (-+) neither a bad or good experience, (+) good experience, (++) great experience, and (+++) amazing experience.

Listening modes	
Embodied listening mode (bodily directness)	• **Sensations related to the physical ears.** •
Embodied listening mode (directness of hearing aids)	• **Connection**. • **Noise filter.**
Perceptual listening mode (outer)	• **Hearing in noisy background.** • **Annoying sounds**.
Perceptual listening mode (inner)	• **Own voice**.
Other listening mode (iconic)	• **Distortion level of own voice**.
Listening attention	
Incidental	• **Background sounds.**
Listening context	
Acoustic environment	• **Noisy environments**
Conclusive remarks	

• **Applied listening modes:**
  o Perceptual listening mode:
  o Causal:
• **Dominant listening mode**: Perceptual.	